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[SECOND SERIES.]

ART. I.—*Notice of Meteoric Iron near Lion River, Great Namaqualand, South Africa; and of the detection of Potassium in Meteoric Iron:* by CHARLES UPHAM SHEPARD, M.D.

1. THE meteoric mass now described, was brought from the Cape of Good Hope to London in July, by Mr. Gill, for Mr. John Gibbs; with instructions to dispose of it there on his account. Prof. J. Tennant, mineralogist to her majesty, having become the purchaser, transferred it to me in a very obliging manner; and it is now deposited in my meteoric collection in Amherst College.

Its weight is 178 lbs. Mr. Gibbs describes it as having been found on a clay plain near Lion river, in the close vicinity of one or more masses, "too heavy for transport;" the removal of the present lump to the Cape by wagon, a distance of nearly 800 miles over the worst possible roads, being spoken of, as attended with no small inconvenience. It having been very securely packed in a box, its surface has been preserved from injury in the most perfect manner; and with the exception of two slight gashes, (apparently made by a saw,) and the abstraction of a slight projection from the larger end, it is as entire as a casting, fresh from its mould. Mr. Gibbs remarks in his note, "the part cut has been done by the Namaquas for fabricating arrow-heads and assagais; the traces of two or three abortive attempts of cutting may also be seen on the surface of the mass."

The box contained several fragments of the clay, spoken of as forming the plain on which the mass was found. This clay is a

compact and hard marl, penetrated by seams of iron-pyrites, which appear to fill spaces once occupied by fossil shells. It may be presumed therefore, that it belongs to the tertiary series in geology; and inasmuch as the iron-mass presents a perfectly clean, and nearly an unoxydated surface, it is possible that its fall has either been very recent, or that it has until lately been imbedded in this formation, and thus preserved from rusting. On the latter supposition, its descent will date back to the geological period of the tertiary.

It is certainly remarkable in the history of these bodies, that their external figure has so often resembled the heads of various animals. The present mass, as figure 1 will show, is another instance of the same fact. It resembles the head of the horse, not only in shape but also in size. Nor is the similarity confined to a single position, but exists whether the mass is viewed on either side, as well as from above, or below; inasmuch as it possesses a wonderful degree of bi-lateral symmetry, having the depressions to a certain extent, repeated on both its sides when in the position of the figure. And what is remarkable also, these concavities are disposed in parallel rows or curves. A curvature upwards is likewise present, thus imparting a slight convexity to the top, and a corresponding concavity to the base. It measures 19½ inches in length, 12 in depth, and 13½ in breadth.

The depressions are every where shallow; and their borders, where they are contiguous to each other, or where they connect with the general surfaces, are softly rounded off; so that there is not a sharp angle or edge upon the mass. Gentle curves and flowing outlines every where prevail, throughout the mass. It can scarcely be said to possess any crust whatever. Its color is blackish iron-gray, mixed with patches of an ochrey brown, through which, a submetallic lustre is rarely visible.

On being struck with a cane, or the handle of a common hammer, a peculiar ringing sound is produced, a circumstance which I have noticed on some other considerable lumps of meteoric iron.

Having sawn a fragment of 120 grains from a projecting ridge, at the larger end, where the natives had chiseled off the piece above referred to, it became apparent that this iron was soft, homogeneous, closely crystalline and perfectly compact. It gave a Gr. = 7·45. When polished and etched, it gave triangular delineations, intermingled with slightly curved, parallel lines; the latter no doubt occasioned by a disturbance of the original structure, in the process of chiseling. The more interior surface, connected with the main mass, was, when etched, destitute of these curved lines, and presented on the whole, a very close resemblance to the Widmannstättian figures of the Lenarto and the Elbogen irons.

This iron does not exhibit the passivity observed by Wöhler in the Green county, Tenn. meteorite and some others; but on the contrary, promptly precipitates copper from a solution of the sulphate of this metal.

It dissolves pretty rapidly in hydrochloric acid, with escape of hydrogen, having nearly the same odor as that evolved from pure iron; but a paper moistened with acetate of lead, acquired a feeble

browning, on being held for some time in the current of the gas. It dissolved without any remainder whatever, in nitro-hydrochloric acid.

The solution in hydrochloric acid was treated for some time with a current of sulphuretted hydrogen. The next day, a feeble cloudiness, of a yellowish brown color appeared in the liquid. It was transferred to a filter; and what remained upon it, after a thorough washing, was treated with strong nitric acid. A heavy powder was formed, and the clear liquid gave no blue color on the addition of ammonia. The powder was heated with carbonate of soda on charcoal before the blowpipe, and the charcoal crushed in a mortar. It gave globules which resembled tin. Twenty-five grs. of the iron were dissolved in nitro-hydrochloric acid, and precipitated by excess of ammonia. A deep blue liquid was obtained on filtration. This was brought to the boiling point, and precipitated by excess of potassa. The green hydrated oxyd of nickel, after being well washed and ignited, weighed 2·04 grs., which equals 1·65 grs. of metallic nickel. It was tested for cobalt before the blowpipe, without affording any indication of its presence.

The peroxyd of iron was ignited for half an hour in a platinum crucible, with its weight of carbonate of soda. Water was boiled upon the fused mass, and after filtration and neutralization with nitric acid, the clear liquid was treated with solutions of hydrochlorate of ammonia and of sulphate of magnesia. An immediate precipitate of the phosphate of ammonia and magnesia was produced, proving that the peroxyd of iron had contained phosphoric acid.

Having observed that the polished face on the mass gathered rust freely, in one spot, though kept in a situation quite free from moisture, I was led to apply a piece of moistened turmeric paper to the oxydated region, when it immediately gave an alkaline reaction. That this effect is not wholly ascribable to ammonia will I think appear from an experiment described at the end of this notice, upon meteoric iron from another locality.

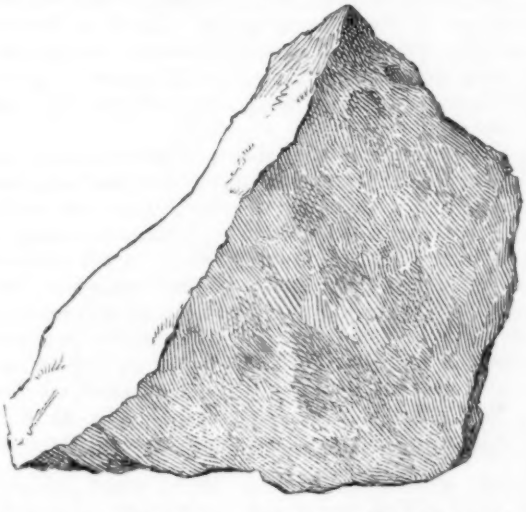
The following therefore is a summary of the results obtained on a single analysis of the Lion river meteoric iron:

Nickel,		6·70
Iron, with traces of Phosphorus, Sulphur, Tin, and Potassium?		93·30
		100·00

2. ***Potassium in the Meteoric Iron of Ruff's Mountain, South Carolina.***—This iron, it should here be mentioned, was not found on that part of the mountain situated in Newberry, as formerly supposed; but in the contiguous county of Lexington.

Having noticed a peculiarity in the manner in which this iron acquires rust, even when kept in a dry air, I suspected that it proceeded, in part, from the oxydation of potassium. The broad flat face of the 55 lbs. mass* figured below, rusts upon one margin to the depth of nearly two inches; and at times obviously

2.



gathers moisture, while the rest of the surface retains its dryness and polish. Turmeric paper applied to the moistened spots were immediately browned. This led me to subject two ounces of the rusted turnings of the iron, obtained in making sections of the mass, to a heat of near redness in a double crucible, for half an hour, and to test the water boiled upon it with reddened litmus and turmeric. It gave an alkaline reaction in both instances, which under the circumstances sufficiently proves that a fixed alkali was present. The deliquescence observed renders it probable, that it was owing to the carbonate of potassa, rather than to the carbonate of soda, although there is nothing to disprove the presence of the latter alkali also.

The condition in which potassium is present is of course only conjectural. It probably exists as an alloy with some of the other metals, which is not uniformly distributed throughout the

* The mass measures 8¾ inches in height, and 7½ inches horizontally across the polished face.

mass. Indeed the artisan who superintended the division of the iron, informed me that he detected a marked difference in the softness and malleability of the metal in particular portions of the mass.

It may also be mentioned, as indicative of the occasional, localized occurrence, of unusual elements in meteoric irons, that in cutting a slice from the very compact Burlington, N. Y. iron, a single, very symmetrical, drop-shaped cavity more than half an inch in diameter was disclosed, which communicated by a minute opening with the surface. Its walls are almost perfectly smooth, and coated by a brownish black powder, not yet examined. The Lenarto iron, also a compact one, contained three empty cavities; and a third iron of the same character, that from Murfreesboro', Rutherford Co., Tenn., had two small cavities, the one two-tenths and the other one-tenth of an inch in diameter. Is it probable that these cavities were originally empty? or if not, with what bodies were they occupied?

If meteorites are, as Baron Reichenbach supposes, miniature representatives of the larger planetary bodies, differing from them only in magnitudes, the chemical constitution now made out for the former, may perhaps be thought to have a bearing upon the views, put forth by Sir Humphrey Davy, in his explanations of volcanoes, relative to the condition of the elements in the interior of our earth, where, as he suggests they may still exist to a large extent, in an unoxydated state. We may at the present moment perhaps be said to have found the following metals in our meteorites in an unoxydated (and in an unchloridized) condition: viz, Fe, Mn, Ni, Co, Sn, Cr, Co, Ar, K, Na, Ca, Mg, Al, Si, P, S, C. Farther researches will doubtless, soon augment the number.

3. *Figure of the Iowa Meteoric Stone, which was seen to fall Feb.* 25, 1847.—This stone was particularly described by me

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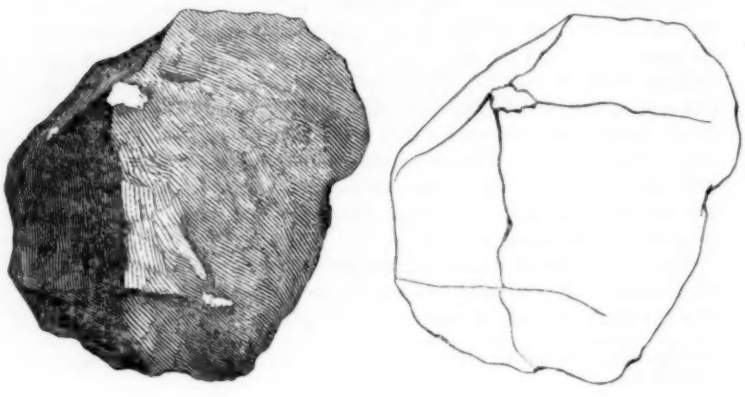

in my report on meteorites published in vol. vi, new series, of the Amer. Journal of Science and Arts, p. 404. The drawings in fig. 3 (as well as those of the two preceding ones) were made by Mr. R. Bakewell. The uncommon completeness and perfection of form in this stone, seemed to render it worthy of being accurately figured. Its greatest diameter is four inches: from the fractured apex of the four-sided pyramid to the centre of the opposite side, measures $3\frac{1}{2}$ inches. It weighs 2 lbs. $8\frac{1}{8}$ oz.

Art. II.—*Notice of Professor Clark's Thesis on Metallic Meteorites.**

Prof. Wm. S. Clark of the Scientific Department in Amherst College has presented a valuable contribution to the science of Astrolithology, in an Inaugural Dissertation on his promotion to the rank of Doctor of Philosophy at the University of Göttingen. The following extracts from the dissertation, are intended to give a general view of such facts and observations as are either new, or at least have not been presented in the pages of this Journal.

The color of meteoric metal varies from silver-white to dull gray, and the hardness from that of the hardest steel to that of metallic copper. The specific gravity is usually between 7 and 8, though rarely as low as 6. It varies exceedingly on different parts of the same mass. The metal is generally very malleable, both hot and cold; and of course difficultly fusible. Wöhler has observed that the metal of some meteorites is in a passive, and that of others in an active condition; so that specimens of some precipitate copper from a solution of the sulphate, while those of others, do not. He infers from his experiments, that all meteoric metal is probably passive at the time of its fall, and becomes active after long exposure on the earth. Besides the chrysolite found in the masses of Krasnojarsk, Atacama, etc.; almost microscopic grains of a mineral harder than glass and resembling the finest quartz sand, are often to be seen in the insoluble residue obtained by digesting pieces of meteoric metal in hydrochloric acid. Stromeyer made a series of experiments upon chrysolite of terrestrial and of meteoric origin; and came to the astonishing conclusion, that the former usually contains nickel, while the latter though imbedded in nickeliferous iron, contains none.

Rumler first discovered arsenic to belong to the meteoric elements, while testing the Atacama chrysolite for water. When meteoric metal is dissolved in an acid, the solution almost inva-

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* Eighty pages 8vo, with 3 lithographic plates. Printed by W. F. Kaestner; Dieterich's University Press.

riably contains phosphoric acid, formed by the oxydation of the phosphurets. It seems indeed, as if phosphorus were as characteristic an ingredient of meteoric masses as nickel; and it is a singular fact, as Wöhler has remarked, that there are no mineral phosphurets of terrestrial origin. The meteoric phosphurets are nearly insoluble in hydrochloric acid; and constitute from 0·5 to 2·5 p. c. of most metallic masses. They form either a black, flocky residue (dyslytite of Shepard); thin, elastic, bronze-yellow plates (schreibersite of Patera); or brilliant four-sided prismatic crystals. They consist of iron, nickel and phosphorus, with perhaps, occasionally, carbon and magnesium.

Prof. Clark observes that he aims to give in his thesis a concise yet complete history of the characteristics and literature of every metallic mass of undoubted meteoric origin, observing that his best thanks are due to his highly honored instructor, Prof. Wöhler, for his kindness in furnishing him with specimens for analysis, and in allowing him free access to his library and cabinet. The classification adopted is to describe first, those containing chrysolite, secondly, such as inclose large quantities of pyrites, thirdly, those rich in nickel, and finally, such as are composed of nearly pure iron.

1. *Krasnojarsk.* According to Rumler, the chrysolite of this and of all Atacama iron contains arsenic.—2. *Atacama.* The chrysolite forms, in bulk, about half the mass. Acids scarcely attack that part of the metal next to the chrysolite, which consequently retains its lustre, while the central portions of the angular masses, when acted on by acids, become dull gray, the whole presenting to view dark areas surrounded by a bright border, which separates them from the chrysolite. These dark areas are often intersected by brilliant lines.—3. *Potosi*, Bolivia, S. A. Partsch believes it to be from Atacama. According to Morren the metallic part consists of iron 90·241 and nickel 9·759. The mass is now in the museum at Angers, France.—4. *Steinbach*, Saxony. The mass was found preserved in the cabinet of von Schönberg of Gotha, with this label, "a curious piece of native iron so discovered in the field." The color of the metal inclines more to gray than that of the masses of Atacama and Siberia. The olivenoid mineral is brownish green, granular, somewhat cleavable, and according to Stromeyer is a tersilicate of magnesia, while the chrysolite of other meteorites is a simple silicate.—5. *Fort Singhur*, near Pouna in the Deccan, India. Described by Giraud in 1849. This mass had the form of an irregular 3-sided prism with conical terminations, and weighed 31¼ lbs. It was found upon a basaltic mountain 4500 feet above the sea. It is exceedingly vesicular, the cavities being filled with an olivenoid substance of a yellowish white color, in opaque, earthy massess of the size of a pea. The metallic portion contains several per cent. of nickel. Sp. gr. =4·72—4·90, Giraud.

—6. *Brahin*, Russia. Discovered in 1810. Two masses, weighing together 200 lbs., now at the cabinet of University at Kiew. The chrysolite forms more than half the mass. Analysis by Laugier,

Iron,	87·35
Nickel,	2·50
Chromium,	0·50
Magnesium,	2·10
Silica,	6·30
Sulphur,	1·85
	100·60

7. *Hommoney Creek*, Buncombe Co., N. C. Prof. Clark has analyzed this somewhat peculiar iron anew, and finds

Iron,	93·225
Nickel, Cobalt,	0·236
Copper, Tin,	0·099
Manganese,	?
Silicon,	0·501
Magnesium,	?
Phosphorus,	?
Sulphur,	0·543
Graphite, Schreibersite,* (Patera,)	4·765

The metal, which is somewhat malleable, exhibits when etched on polished surfaces, in some places, a dull, gray field with a few bright points, and in others, very minute, yet distinct and beautiful, triangular figures. The hardness is exceedingly variable, and seems to be greatest where the figures are most readily brought to view. The analysis was made from a very hard piece about three grammes in weight. It was digested in hydrochloric acid until hydrogen gas ceased to be evolved. That which was generated possessed an exceedingly disagreeable odor, and being conducted through a solution of silver produced a slight precipitate of sulphuret. The insoluble residue retained the form of the original fragment, and consisted of brilliant scales of graphite, a black, flocky substance and a magnetic portion, which under the microscope appeared to be a network of crystalline plates, intersecting each other at angles of about 60° and 120°, exactly resembling the figures, exhibited by an etched surface of the mass at this place. The magnetic portion was fused with carbonate and nitrate of soda. The mass, which was col-

* The name Schreibersite, here applied to the difficultly soluble compound of iron, nickel and phosphorus, refers to the substance which was previously designated dyslytite by Shepard.

ored by manganese, was then digested in water, and the colorless fluid filtered from the metallic oxyds. This was tested in the usual way with a solution of magnesia and with molybdate of ammonia, and found to contain phosphoric acid. The oxyds were dissolved in hydrochloric acid, and the iron precipitated by ammonia. The filtrate was treated with hydrosulphuret of ammonia, which threw down a black sulphuret, insoluble in dilute hydrochloric acid. The quantity was too small for nearer examination. The plates which appear to produce the figures in this meteorite are therefore in all probability, the phosphuret of iron and nickel, though present in small quantity and very unequally disseminated through the mass. A number of brownish particles, harder than glass, and resembling the granular chrysolite of the Atacama iron, were also observed in the insoluble residue. The solution filtered from the insoluble portion was saturated with sulphuretted hydrogen gas, and the light brown precipitate formed was collected on a filter, washed, roasted and weighed. It was then reduced with soda before the blowpipe, and yielded a malleable globule of a reddish white color, containing copper and tin. The sour solution, filtered from the sulphurets, was boiled to expel the excess of sulphuretted hydrogen, and the iron oxydized with chlorine gas and precipitated by means of succinate of ammonia. After weighing, the oxyd of iron was fused with carbonate of soda and found to contain phosphoric acid and silica. The filtrate from the iron was concentrated by evaporation, and treated with a slight excess of sulphuret of hydrogen and ammonia, by which a few milligrams of the sulphurets of cobalt and nickel were precipitated. After the fluid became clear and colorless, it was filtered, and the sulphurets roasted and weighed. Tested before the blowpipe, the oxyds obtained appeared to contain much more cobalt than nickel. The solution filtered from the sulphurets was evaporated to dryness, the ammoniacal salts driven off, and a small quantity of magnesia thus detected.

8. *Bitburg*, in the Eifel. Found in 1805. Described by Col. Gibbs. Weight 3300 to 3400 lbs. This enormous mass was discovered in repairing a road and was heated and hammered at an iron furnace with the exception of a few ounces. It contains a light green olivenoid substance in small quantity, irregularly scattered through its mass. Sp. gr. = 6·52, Rumler. Analyses:

	Stromeyer.	John.
Iron,	81·8	78·82
Nickel,	11·9	8·10
Cobalt,	1·0	3·00
Manganese,	0·2	
Silicon,		0·05
Silica,		5·50
Sulphur,	5·1	4·50
	100·00	99·97

9. *Rasgata*, New Grenada. Discovered in 1810. Described by Rivero and Boussingault in 1823. Weight of smaller mass 45 lbs., of larger 84 lbs. A vesicular mass containing cavities of various sizes which are partly filled with pyrites. Metal hard, but quite malleable. Sp. gr. = 7·3 – 7·7, Rumler. Analyses:

	Wöhler.	Riv. and Bouss.
Iron,	92·35	90·76
Nickel,	6·71	7·87
Cobalt,	0·25	
Phosphorus,	0·25	98·63
Schreibersite,	0·08	
Chrysolite?	0·11	
Copper,	?	
Tin,	?	
Sulphur,	?	
	99·85	

10. *Santa Rosa*, 60 miles northeast of Bogota, New Grenada. Found in 1810 by Cecelia Corridor. Described by Rivero and Boussingault in 1823. Weight 1575 lbs., besides which several smaller masses were found in the same vicinity. Malleable, vesicular, resembling that from Rasgata. Sp. gr. = 7·30. Analysis by Riv. and Bouss.

Iron,	92·23
Nickel,	8·21
Insoluble,	0·28
	99·72

11. *Zacatecas*. Described in the Gazeta of Mexico, April 3d, 1792. Weight about 2000 lbs. This is mixed with an unusually large quantity of pyrites, partly in globular masses which are connected together by the same mineral, so as to form on polished surfaces a sort of imperfect network. Widmannstättian figures are not to be detected. Sp. gr. = 7·55, Rumler. Analysis by Bergemann.

Iron,	85·094	Nickeliferous iron,	93·77
Nickel,	9·895	Magnetic pyrites,	2·27
Cobalt,	0·668	Chrom. iron,	1·48
Copper,	0·030	Schreibersite,	1·65
Magnesium,	0·187	Carbon,	0·49
Carbon,	0·164		99·66
Graphite,	0·334		
Schreibersite,	1·646		
Chrom. iron,	1·482		
Sulphur,	0·845		
Manganese,	?		
	99·348		

12. *Bohumilitz.* Found in 1829. Described in 1830. Weight 103 lbs. Preserved in the National Museum at Prague. Was covered with a thick crust of limonite. It is composed of a metallic mass, a large quantity of magnetic pyrites and an unknown substance, which is black, not very hard and not graphite. The black mineral occurs in the interior as well as at the surface of the mass, sometimes in portions nearly an inch in length, and is intimately mixed with finely divided metal and pyrites. These black masses are enclosed in a coating of magnetic pyrites. Analysis by Berzelius.

Iron,	92·473		94·775
Nickel,	5·667		3·812
Cobalt,	0·235		0·203
Insoluble,	1·725		2·200
	100·000		100·000

Berzelius dissolved 60 grammes of filings from the mass in nitric acid, and found, of insoluble carbonaceous matter, 0·672 grammes, and of crystalline magnetic scales, 0·777 grammes. The first contained carbon, alumina, silica, iron, nickel, phosphate and chromate of iron. The second consisted of

Iron,	65·987
Nickel,	15·008
Silicon,	2·037
Carbon,	1·422
Phosphorus,	14·023
	98·467

This is the substance which is now regarded as a phosphuret of iron and nickel called Schreibersite by Patera, after von Schreibers.*

13. *Bahia*, Brazil, 10° 30′ S. lat., 33° 15′ W. long. from San Salvador. Discovered by Bernardus da Mota Botelho in 1784. Described by A. F. Mornay in 1816. This mass was seven feet long, four wide and two thick, and weighed 17,300 lbs. Exhibits imperfect Widmannstättian figures and contains small quantities of magnetic pyrites. Analysis by Wollaston.

Iron,	94
Nickel,	4
	100·

15. *Black Mountain*, North Carolina.—16. *Crosby's Creek*, Tenn. According to Prof. Wöhler, the specimens of this meteorite bear a striking resemblance to those of the mass from Szlanicza.—17. *Tucuman*, Argentine Republic. Described by Don

* But previously called dyslytite by Shepard in his Report on American Meteorites

Miguel Rubin de Celis in 1783. Weight 30,000 lbs. A mass weighing 1400 lbs. in the British Museum is believed to be from the same locality. This mass was covered with a crust of oxyds four to six inches thick, on the under side. It has cavities of various sizes, which are more or less filled with magnetic pyrites. Structure highly crystalline, and when etched presents surfaces resembling crystalline masses of antimony and bismuth. It is very malleable. G.=7·54–7·6, Rumler. Analysis by Howard.

Iron,	90
Nickel,	10
	100

18. *Senegal*, the Upper Senegal, Africa. Made known by Compagnon in 1717. Vast quantities are said to be scattered over the countries in the Bumbuk and Siratik countries, several pieces of which have been brought by the negroes to Fort St. Louis at the mouth of the Senegal. Compact, with a very slight admixture of magnetic pyrites. By etching, short raised lines appear, which are parallel or intersect each other at various angles presenting like the Tucuman iron, a striped or plumous appearance. When deeply etched the surface becomes granular. G.=7·72, Rumler. Analysis by Howard.

Iron,	95
Nickel,	5
	100

19. *Cape of Good Hope*, between Sunday and Boschesman's rivers, Cape Colony, Africa. Discovered in 1793. Described by Barrow in 1801, and by van Marum in 1804. The original mass weighed over 300 lbs., of which 171 lbs. are now in the cabinet of Natural History at Haarlem in Holland. Capt. Alexander discovered in 1837 great numbers of metallic masses, supposed to be meteoric, over a large extent of country along the Great Fish River in Cape Colony, which are supposed to belong to the same fall with the above. Compact, with a small quantity of finely divided magnetic pyrites. When etched exhibits no Widmannstättian figures. G.=6·63–7·94, Rumler. Analysis by Wehrle.

Iron,	85·608
Nickel,	12·275
Cobalt,	0·887
	98·770

20. *Lenarto*, Hungary. Found in 1814. Weight 194 lbs., (Austrian,) of which 134 are now in the National Museum at Pesth. It possessed an irregular, tabular form, and was highly crystalline. It was covered with a crust of dark brown metallic oxyds, and contained three empty cavities. It contains magnetic

pyrites in the form of small grains and lines, as well as in larger, reniform and cylindrical masses. Widmannstättian figures very distinct, which are mostly isosceles triangles, the bands crossing at angles of about 77° and 26°. Gr. = 7·73, Rumler. Analyses:

	Clark.	Wehrle.
Iron,	90·153	90·883
Nickel,	6·553	8·450
Cobalt,	0·502	0·665
Manganese,	0·145	
Copper,	0·080	99·998
Tin,	0·082	
Sulphur,	0·482	
Phosphorus,	?	
Insoluble phosphurets,	1·226	
	99·223	

Two analyses were made of filings from this meteorite, of which the mean result is given above. For one analysis 5·74 grms. were taken, and for the other 2·074 grms. The method employed was, in general, like that adopted in the analysis of the Hommoney Creek meteorite. The sulphur was determined as sulphuret of silver, and sulphate of baryta. The tin and copper were precipitated by sulphuretted hydrogen, roasted, reduced with carbonate of soda and borax, and tested, both in the wet and in the dry way. The iron was precipitated as succinate. In washing the precipitate, a small quantity was dissolved, although the solution had been rendered exceedingly basic before the addition of the neutral succinate of ammonia, and then heated to boiling before filtration. This was probably owing to the presence of phosphoric acid, which appears almost invariably to be formed by the solution of meteoric metal in hydrochloric acid. The nickel, cobalt and manganese were thrown down by hydrosulphuret of ammonia, and the solution allowed to stand till it became colorless and clear, when it was filtered off, and evaporated almost to dryness. A few drops of hydrosulphuret of ammonia now precipitated a small quantity of nickel. The sulphurets were then dissolved in aqua regia, and thrown down by potassa. After weighing, the oxyds were redissolved in hydrochloric acid, reprecipitated by potassa, brought upon a filter and washed. The moist oxyds of nickel and cobalt were then dissolved upon the filter by a mixture of solutions of potassa and prussic acid, the manganese remaining undissolved. The solution was boiled to expel the excess of prussic acid, and to change the cyanid of cobalt and potassium, to sesquicyanid. The nickel was then precipitated by boiling with freshly prepared oxyd of mercury. The cobalt was determined qualitatively by neutralizing the alkaline filtrate with nitric acid, and throwing down the cobalt by means of nitrate of suboxyd of mercury; and

quantitatively by the loss. The black, flocky, insoluble residue was digested in hot nitric acid, and was completely dissolved with the exception of a few pieces of a mineral, which might have been chrysolite; though perhaps only quartz mixed with the filings. The solution contained phosphoric acid, iron and nickel.

21. *Agram*, (Hraschina) Croatia. This most interesting meteorite, which fell May 26, 1751, and for nearly 100 years was the only one of the metallic class positively known to have fallen from the heavens, was first seen as a brilliant fire-ball passing from west to east through a cloudless sky at 6 P. M., attended with a noise like that produced by heavy wagons rapidly passing over a paved road. When almost directly over the village of Hraschina, it burst with a tremendous explosion into two pieces, and at the same moment became enveloped in a cloud of smoke, which was at first black, and then presented a variety of colors. The fall was followed by a terrible crash, and a trembling as from an earthquake. The larger fragment, which weighed 71 lbs., (Austrian,) made an opening in the earth 18 feet deep and 2 feet wide, while the smaller of 16 lbs. weight buried itself in a meadow 2000 paces distant. The large mass was presented to the Emperor Francis I, and the Empress, Maria Theresa, by the Bishop of Agram, and is preserved in the Imperial Museum at Vienna: the smaller mass is missing. The mass has a triangular, tabular form, with one side convex and the other slightly concave. It has a complete crust, in which is enclosed no gravel or earthy matter, as must have been the case had it been in a liquid condition. It undoubtedly came to the earth in a glowing state, and revolving rapidly like a circular saw, so as to strike the ground edgewise, and thus penetrate to such an astonishing depth. The surface presents the usual concavities. The crust is brownish-black and without lustre, with a thickness of about three-fourths of a line, though varying on different parts. It is somewhat fibrous in structure, and readily separated from the metal beneath, which then appears smooth and polished. On the convex side of the mass, the crust contains numerous fissures, usually about one-half inch long, though rarely from one to two inches, and from two-twelfths to three-twelfths of a line deep. The mass contains occasional intermixtures of magnetic pyrites, and displayed on fractured surfaces a crystalline structure. When etched, it exhibits most perfectly those characteristic figures which were first discovered in this iron, by Widmannstätt in Vienna in 1808. Gr. = 7·72 – 7·82, Rumler. Analyses:

	Klaproth.	Wehrle.
Iron,	96·6	89·784
Nickel,	3·5	8·886
Cobalt,		0·667
	100·1	99·337.

22. *Elbogen*, near Carlsbad in Bohemia. Described by Neumann in Prague in 1811. This mass was for many years preserved in the town-house at Elbogen under the name of "the enchanted Burgrave," and therefore probably fell about the close of the 14th century, when for a few years Elbogen was governed by burggraves. It weighed 191 lbs., 141 lbs. of which are now in Vienna and 11½ in Prague. It was described by Chladni as having resembled a horse's head. It contains here and there, small masses or veins of magnetic pyrites. When etched, it exhibits the Widmannstättian figures. Gr. =7·74, Rumler. Analysis by Berzelius.

	Metal.		Insoluble.
Iron, -	88·231	-	14·17
Nickel, -	8·517	-	17·72
Cobalt, -	0·762		
Magnesium, -	0·279	-	?
Phosphurets, -	2·211	Phosphorus,	14·17
Sulphur, -	?		
Manganese, -	?		
	100·00		

23. *Otsego County*, N. Y.—24. *Ruff's Mountain*, S. Car.—25. *Szlanica*, near Arva, Hungary. Found in 1843. Described by Haidinger in 1844. Discovered in digging for iron-ore, and was invested by a thick crust of hydrated oxyd of iron, in which were observed a few crystals of vivianite. The mass consists of a multitude of small, ellipsoidal globules of metal, apparently cemented together by thin veins of pyrites and crystalline plates of schreibersite. The pyrites occurs also, in small, compact masses. When etched on polished surfaces, it displays no Widmannstättian figures, but becomes dull and of a light gray color. The edges of the plates of schreibersite appear upon such surfaces as brilliant lines and bands, arranged without order and of various dimensions, sometimes being half an inch in length, and one-twelfth in thickness. Analysis by Patera and Lowe.

Iron, -	89·42	- -	90·471
Nickel, } Cobalt, }	8·91	- -	7·321
Schreibersite, Silicon, Carbon, Copper, Sulpher.	1·41	Cobalt, Schreibersite, Silicon, Carbon, Sulphur,	1·404
	99·44		99·169

The schreibersite, Patera. Magnetic, elastic, bronze-yellow plates. H. = 6·6. Gr. 7·01–7·22.

Iron, - - - - -	87·20
Nickel, - - - -	4·24
Phosphorus, - - - -	7·26
Carbon, - - - -	?
	98·7

26. *Seeläsgen*, near Schwiebus in Silesia, Austria. Described by Göppert in 1847. Found in ditching a meadow among boulders of primitive rocks, fourteen feet beneath the top of the ground; and was sold for old iron to a blacksmith. Weight 218 lbs. It was covered with a dark brown crust of oxyds from one-fourth to three-fourths of a line in thickness. The indentations upon its surface were quite striking. The metal is malleable, homogeneous, of a light steel gray color, and contains an unusual quantity of a very insoluble pyrites, which is disseminated through the mass in irregular veins, in long, cylindrical portions, and in minute spherical globules. This pyrites is of a grayish brown color, inclining to bronze-yellow, rarely tarnished pinchbeck brown or bluish, with a dull metallic lustre. The small globules are darker colored and more compact than the rest, so as to be capable of taking a polish. The streak is grayish black, and the cleavage, octahedral. Multitudes of zigzag seams run through the mass, sometimes forming cells, the surfaces of which are scoriaceous and jagged, and coated with an earthy substance of a blackish brown color. These cells also contain numerous spherical globules of pyrites, and according to Partsch, small isolated masses of metal. Where the cells open on the surface of the mass, may be seen numerous arborescent, metallic points, and the black earthy mineral is apparently changed to hydrated oxyd of iron. The fracture is lamellar in one direction, but otherwise granular. Etched surfaces appear rough and granular, exhibiting only a few short fine, parallel, depressed lines, but no Widmannstättian figures. H.=4. Gr.=7·63–7·73. Gr. of pyrites =4·787, Rammelsberg. Analyses:

	Duflos.		Rammelsberg.
Iron, -	90·000	-	92·307
Nickel, -	5·308	-	6·228
Cobalt, -	0·434	-	0·667
Manganese, -	0·912	Tin,	?
Copper, -	0·103	-	0·049
Silicon, -	1·157	-	0·026
Schreibersite, }	0·834	-	0·183
Graphite, }		Carbon,	0·520
Chromium, -	?		?
	98·749		100·000

Rammelsberg infers from his analysis that the pyrites is a simple sulphuret, Fe S. Its composition is,

Sulphur,	28·155
Iron,	65·816
Nickel,	1·371
Cobalt,	1·371
Copper,	0·566
Protox. iron,	0·874
Chrom. iron,	0·858
	100·011

The insoluble portion after the separation of the silica and carbon, contains, according to Rammelsberg,

	(*a*)	(*b*)
Iron,	59·23	61·13
Nickel,	26·78	28·90
Copper,	0·78	?
Tin,	0·20	?
Phosphorus,	6·13	7·93
Sulphur,	?	0·26
	93·12	98·22

27. *Hauptmannsdorf*, near Braunau in Bohemia. Fell July 14th, 1847. Described by Beinert in 1847. At break of day, the inhabitants of Braunau and vicinity were startled by a violent, roaring sound, which continued for some minutes. A small, black cloud was observed over the village, which suddenly glowed as if on fire, and sent out flashes of light in all direction. Two fireballs fell from the cloud attended by two explosions, like the report of cannon. It having been reported that lightning had struck in a neighboring field, the place was visited, and a metallic mass found, which had buried itself to the depth of three feet in the earth, and which six hours after the fall was so warm, that it was impossible to bear the hand upon it. It was subsequently found also that a dwelling-house, half a mile from Braunau had been struck, and that another fragment of the meteor had broken through the roof, passed through the chamber in which persons were sleeping and buried itself in the side of the house. The larger mass weighed 42 lbs. 3 oz. (Austrian), the smaller, 30 lbs. 8 oz. The former was cut up for furnishing specimens to cabinets, the latter is still entire, and in the possession of the abbot of the monastery of Braunau. The larger fragment had the form of an irregular rhomboid; while the smaller resembles a huge oyster shell. Both were covered with more or less regular hexagonal concavities. The color is iron-gray, and in the concavities, reddish brown, from a small quantity of me-

tallic oxyds. It is highly crystalline within, so that it may be cleaved in three directions, parallel to the faces of a cube almost as easily as galena. A piece from the larger mass in the Imperial Museum at Vienna weighs about 4 lbs., and is described by Haidinger as being apparently an individual crystal. The metal is remarkably homogeneous, and presents to view on etched surfaces, three series of fine parallel lines, which intersect each other in the usual manner. It is malleable, very hard, and of light steel-gray color. Gr. = 7·71. Analysis by Duflos and Fischer.

Iron,	91·882
Nickel,	5·517
Cobalt,	0·529
Manganese, Copper, Arsenic, Calcium, Magnesium, Silicon, Chromium, Sulphur, Phosphorus, Carbon, Chlorine,	2·072
	100·000

28. *Asheville*, N. C.—29. *Caille*, near Grasse, Dept. du Var, France. Discovered to be meteoric by Brard in 1828, though it had served as a bench before the parish church for more than 200 years. It is crystalline and cleavable; and contains a small quantity of magnetic pyrites. The figures brought to view by etching are bounded not by straight, but by sinuous, raised lines. Gr. = 7·64. Analysis by De Luynes.

Iron,	82·63
Nickel,	17·37
Copper,	?
Manganese,	?
	100·00

30. *Durango*, Mexico. Described by A. von Humboldt in 1811. Weight 30,000 to 40,000 lbs. The mass lies in the city of Durango; only a few small specimens having been detached from it. It is compact, but exceedingly cleavable; and incloses a small quantity of magnetic pyrites. Very perfect Widmannstättian figures are visible on etched faces. The bands are often so wide and so near together as to have scarcely any intervening spaces. Gr. = 7·88, Rumler.—31. *Claiborne*, Ala.—32. *Schwetz*, on the

river Weichsel, Prussia. Found in 1850. Described by G. Rose in 1851. Weight 43 lbs. 4 oz. Discovered in excavating a sand-hill on the line of the East Railroad, at the depth of four feet. It had the form of a right rectangular prism, with rounded edges. It was inclosed in a thin crust of hydrated oxyds, and intersected by two or three seams, so that by means of chisels and hammers, it was easily divided into three pieces. The most of it is preserved in the Royal Museum at Berlin. The metal incloses a few small masses of magnetic pyrites. It exhibits when etched, the Widmannstättian figures very perfectly, the whole surface being ornamented by two sets of very long, straight bands one-eighth of an inch wide, which cut each other at angles of 60 and 120°, while a third set much wider and shorter, intersect these somewhat irregularly. Gr. = 7·77, Clark. Analysis by Rammelsberg.

	Metallic portion.		Insoluble part.
Iron, -	93·18	-	22·59
Nickel, -	5·77	-	34·77
Cobalt, -	1·05	Copper,	4·74
Insoluble, -	0·96	Chromium,	3·90
		Phosphorus,	34·13
	99·98		100·13

33. *Texas.*—34. *Carthage*, Tenn.—35. *Guildford*, N. Car.—36. *Burlington*, N. Y.—Prof. Clark gives a new analysis of this very beautiful meteorite, so remarkable for the white color of its metal and the peculiar pattern of its etched surfaces.

Iron, - - - -	89·752
Nickel, - - -	8·897
Cobalt, - - - -	0·625
Copper, - - - -	?
Manganese, - - - -	?
Insoluble phosphurets, - -	0·703
	99·977

37. *Xiquipilco*, north of Toluca, Mexico. Mentioned in 1784 in the Gazeta de Mexico, in which it is said that small pieces from a few ounces to 50 lbs. in weight were very numerous; that these were sought for by the Indians after heavy rains, and used by them for the fabrication of agricultural implements. It is compact and without any visible intermixture. It presents the Widmannstättian figures very perfectly. Gr.=7·72, Rumler. Analysis by Berthier.

Iron, - - - -	91·38
Nickel, - - - -	8·62
	100·00

According to Manross, it contains cobalt.—38. *Sierra Blanca*, Mexico. Mentioned in the Gazeta de Mexico in 1784, where it is stated that masses of native iron weighing 2000 lbs., 3000 lbs., and even more, had been found among these mountains. When etched, exhibits Widmannstättian figures, similar to those on the Durango mass.—39. *San José del Sitio*, Mexico. Discovered by Sonneschmidt in the corner of a church-yard in Charcas, partially buried in the earth. The projecting portion was 2½ feet long and one foot in diameter. It was said to have been brought from the estate of San José del Sitio, where several masses had been found imbedded in a limestone, probably of tufaceous origin.—40. *Jackson County*, Tenn.—41. *Babb's Mill*, Tenn. Prof. Clark reanalyzed this iron, detecting 2·037 p. c. of cobalt, and making the proportion of nickel as high as 17·1 p. c.—42. *Chesterville*, Chester county, S. Car.—43. *Murfreesboro'*, Tenn. —44. *De Kalb county*, Tenn.—45. *Charlotte*, Tenn.—46. *Smithland*, Tenn.—47. *Grayson county*, Va.—48. *Roanoake county*, Va.—49. *Oaxaca*, Mexico. Described by Partsch. Brought from Mexico by Baron Karawinsky of Munich. The metal is compact, and exhibits on etched surfaces crooked bands, the crystalline structure having been apparently distorted by hammering. Gr. = 7·38, Rumler.—50. *Greenland*. Described by Capt. Ross in 1819. The attention of the Captain was attracted to it by the fact that the Esquimaux of the coast used implements of iron. Upon inquiry he learned that they procured the material from a large mass of native metal lying thirty miles inland, near which they informed him was a huge stone containing globules of metallic iron. It is very malleable, silver-white, and not easily oxydized. It contains nickel, pyrites, and a black unknown mineral, and when etched, exhibits fine crooked bands, the original structure having been distorted by hammering. Gr. = 7·23, Rumler. According to Brande contains 3 p. c. of nickel.

51. *Petropawlowsk*, Altai, Siberia. Described by Sokolowskji in 1841. Several small specimens of meteoric metal were found at the depth of 31½ feet below the surface. The largest mass was of irregular form, and coated with a crust of hydrated oxyds. Its weight was 17½ lbs. Gr. = 7·76. Analysis by Sokolowskji.

Iron, - - - -	97·29
Nickel, - - - -	2 07
	99·36

52. *Alasej mountains*, Siberia. Large quantities of excellent iron are said to be found among these mountains and to be employed by the natives in the manufacture of knives, wedges, etc. —53. *County Down*, Ireland?—54. *Scriba*, N. Y.—55. *Walker county*, Ala.—56. *Randolph county*, N. Car.—57. *Bedford county*,

Penn.—58. *Pittsburg*, Penn.—59. *Salt River*, Kentucky.—60. Locality unknown. A specimen weighing two ounces, and found among the minerals of Prof. Stromeyer, by Prof. Wöhler of Göttingen. Gr.=7·547. Analysis by Manross.

Iron,	92·33
Nickel, Cobalt,	7·38
Tin,	0·03
Phosphuret of Iron and Nickel,	0·42
	100·16

Prof. Clark has omitted to mention the St. Augustine's Bay, Madagascar, locality of meteoric iron, where the quantity is reported to be immense;* and since the publication of his paper has appeared in the proceedings of the 6th meeting of the Amer. Association published the present year, the notice (p. 188) by Dr. Le Conte of two large pieces of meteoric iron seen by him while passing through the village of Tucson, a frontier town of Sonora, near the Gila.

ART. III.—*Remarks on the Distortion of the Achenium in certain species of Carex;* by JOHN CAREY.

SOME time ago, when preparing an arrangement of the genus Carex, for Dr. Gray's *Manual of the Botany of the Northern United States*, I observed that the specimens, in his herbarium, of *C. crinita*, Lam., *var. paleacea*, had the achenia variously distorted. Supposing, however, that this might be accidental, I took no notice of the fact in my description of the species, and had almost forgotten the circumstance when my attention was recalled to it by some specimens received from Northern New York. Finding in these the same anomaly, I have since carefully examined such specimens as have fallen under my notice, and I now submit the result of my observations, which, as I have not met with any allusion to the subject, may be of some interest to botanists.

The normal shape of the achenium, in C. crinita is lenticular and slightly obovate (fig. 1); but this I have scarcely ever observed in the var. *paleacea*, the most common form in the Northern and Eastern States, distinguished by the *very long* awn of the scales. In this variety I find the achenia to exhibit almost every gradation from the nearly perfect type, to the most distorted form.

* See Proceedings of Amer. Association of the Geologists, at New Haven, April, 1845, p. 40.

The deformity appears, most generally, to consist in an imperfect development of the albumen, on one side; causing an indentation, which, at maturity, bends down the apex of the achenium, rounding, proportionably, the perfect side. (Fig. 2, *in the young state*, fig. 3, *at maturity.*) But this, though the most common, is by no means the constant appearance presented, as I notice that the achenium is sometimes indented on *both* sides, and it is then

completely panduriform at maturity, (fig. 4.) Occasionally it is doubled across the widest surface or face of the achenium, (fig. 5, *longitudinal section;*) but there are many modifications of all these irregularities of which I merely describe the principal forms. The perigynium, being somewhat inflated, is not exactly conformed to the misshapen achenium. Sometimes it is partially so, but usually it presents an irregular, rounded outline.

This remarkable anomaly led me to examine such specimens as I possess of the closely allied species, C. maritima, *Vahl.*, and C. salina, *Wahlenb.*, both of which have long-awned scales. Of the first, I have a single mature specimen from Sweden; also a specimen (probably American) from the herbarium of Dr. Torrey, and two or three perigynia from a specimen, in the same, collected by Richardson in the Hudson's Bay region. The whole of these exhibit the same extraordinary contortion of the achenium. Some Norwegian specimens, in my herbarium, are too young to determine the question, as I do not notice the deformity in an early state of the ovary. Of C. salina, I have a single specimen from British North America,* and another from Sweden, both showing the same distortion; and the latter has a seta arising from the base of the achenium, but not exserted through the orifice of the perigynium. A very young specimen of Hornemann's (probably from Greenland) has the ovary apparently bent. With respect to these two very uncommon species, I have not the means of ascertaining whether the plants having perfect achenia are found with shorter-awned scales, a question more readily determinable by the botanists of Northern Europe, than with us. Kunth, (*Cyp. Synopt.*) under C. maritima, says, "Achenium immaturum *oblique* obovato-oblongum," and this

* This is one of the original specimens from Cumberland House, to which Dr. Boott (Flor. Bor.-Amer.) correctly refers C. lanceata, *Dewey;* founded, in part, upon this species, mixed up with young specimens of C. livida, *Willd.* The original character of C. lanceata seems to have principal reference to the latter, it being described as tristigmatic, by the author, who also notices its resemblance to his C. Grayana, correctly referred, I conceive, to C. livida. The "staminate spikes 1–3," and possibly some other parts of the character of C. lanceata, belong to C. salina, a distigmatic species

was, probably, the early appearance of the distortion; but he does not seem to have seen ripe specimens. He also describes a Brazilian species, C. procera, with a "mucronate-subaristate" scale, of which he says, "Ovarium oblongum, triangulare, ad unum latus versus medium emarginato-incisum. Achenium oblique oblongum, triangulare, ad angulum rectilineum versus medium emarginato-incisum (semper?)." This species is altogether unknown to me, and I am indebted to my friend, Dr. Boott, of London, for the reference—but, it belongs to a very different group from those to which I have referred, being tristigmatic, and described as "C. ripariæ et C. paludosæ similis et affinis."

It is not my intention, in these remarks, to speculate upon the cause of this malformation, but merely to call the attention of botanists to the subject, more especially with reference to C. crinita, which is so universally diffused throughout the United States. Assuming that the plants with shorter awns, bearing perfect and regular achenia, are to be taken as the type of the species, I conceive that the very prolonged awn is an irregular (morbid?) appearance, consequent, probably, upon the disturbing causes, whatever these may be, to which the distorted achenia are attributable. I have imagined that the lengthened awn might be somewhat analogous to the irregular hairs found upon various galls, on the leaves and branches of plants. I have not, however, been able to detect any appearance of injury from insects, or otherwise, in the variety *paleacea*, which, as I have remarked, seems to be the more common form in the Northern States, and is equally robust and vigorous in growth with the regular type of the species. It would be interesting to find a specimen in which *one* or *two* of the fertile spikes should present the long-awned scales, accompanied by the distorted achenia, whilst the remainder were in the normal condition; but this I have never observed; nor yet a regular spike on the paleaceous form of the species. In C. stricta, *Lam.*, a species of this group, it is not uncommon to find both perigynium and achenium tumid and enlarged, but without distortion in the shape of the latter, or prolongation of the scale, so far as I have observed.

I learn from Dr. Boott, who has seen an authentic specimen, that C. paleacea, *Wahl.*, is referable to C. maritima, and it will therefore be proper to drop that name for the long-awned variety of C. crinita, which, if my views should be confirmed by the observation of botanists, may be distinguished as C. *crinita*, var. *morbida*.

ART. IV.—*On the Reproduction and supposed Existence of Sexual Organs in the Higher Cryptogamous Plants;* by ARTHUR HENFREY, F.L.S.

[Concluded from vol. xiv, p. 389.]

Lycopodiaceæ.—The fructification of this family consists, as is well known, of spikes clothed with fruit-leaves, bearing on their inner faces sporangia containing spores. These spores are of two kinds. One sort occur in large numbers in their sporangium, and are very small; the others are much larger, and only four are met with in a sporangium. Spring,* who has devoted great attention to the general characters of the Lycopodiaceæ, has given especial names to the two kinds of sporangia; those with the four large spores he calls oophoridia, those with the small spores antheridia; yet he did not mean to attribute a sexual antithesis, merely a morphological one, as he expressly states.

The general impression, however, with regard to the import of the two kinds of spores has long been, that the large spores alone are capable of producing new plants; and five years ago Dr. C. Müller published an elaborate account of the development of the Lycopodiaceæ,† in which the germination of the large spores was described at length. The following are the essential results of his investigations.

The large spores are more or less globular bodies, usually flattened on the surfaces by which they are in contact in the oophoridium; thus, while the outer side has a spherical surface, the inner side has three or four triangular surfaces, as in *L. selaginoides*, and *L. denticulatum*. They possess two coats, the outer very thick and composed of numerous cells, the cavities of which are almost completely filled up by deposits of secondary layers. This outer coat exhibits various forms of raised markings on its outer surface, and in some cases these seem to form a distinct layer, a kind of cuticle, capable of being separated from the subjacent cells. The inner coat of the spore is *usually* perfectly structureless, and not very firmly attached to the outer coat. In *L. gracillium*, Dr. Müller observed below the outer coat a structure composed of a layer of rather large parenchymatous cells, which could be easily isolated; and as there was no structureless membrane within this, he regarded the layer as the proper inner coat. This observation is important in relation to the discrepancies between Dr. Müller's statements and those of Mettenius, to be spoken of presently. The cavity of the spore is filled with granular mucilage.

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* Flor. Brasiliensis, 106–108.

† Botanische Zeitung, July 31, 1846, *et seq. num.* Ann. of Nat. Hist., vol. xix, 1847.

When the spore is placed in favorable circumstances for germination it begins to swell up, and if the contents be examined with the microscope, a few minute cells will soon be found to have become developed in the mucilage. This cell-formation commences at a determinate spot upon the inner coat of the spore, the cells being so firmly applied that they appear blended with this inner membrane. The cell-formation goes on till an obtuse conical process is developed, which breaks through the outer tough coat of the spore, and this process is recognized as the germinal body, or *keim-körper*, corresponding to the pro-embryo of the other Cryptogams. From this, which at this period does not by any means fill the cavity of the spore with its lower portion, an ovate process is produced, at first obliquely directed upwards, the bud of the future stem, and a conical process taking the opposite direction representing the radicle. On the ascending process a distinction can soon be observed between the terminal bud, a little oval body, and a short thread-like stem on which it is supported; as the bud opens, the leaves appear in pairs.

At the conclusion of the paper, Dr. Müller offers some remarks on the evidence with respect to the import of the spores, the substance of which may be transcribed. "Up to the present time it remains doubtful what purpose is served by the antheridium-spore. Some persons maintain one opinion, others another. One author declares he has seen it germinate, another that he has never been able to do so. Kaulfuss* relates that Fox sowed *Lyc. elago*, and Lindsay *L. cernuum* with success, and that *L. clavatum* sprung up abundantly with Willdenow. With himself it did not succeed; but the garden-inspector, Otto of Berlin, raised *L. pygmæum* several years in succession from seed. The last case however is readily explicable, since *L. pygmæum* possesses oophoridia."

Göppert† however states that he has seen the development of young plants from antheridium-spores in *L. denticulatum*. Dr. Müller expresses some doubt as to whether the observation was absolutely exact, since Göppert never mentions seeing a young plant actually adherent to an antheridium-spore, neither does he give the structure of the leaf, and the young plant he figures closely resembles a *Fissidens*, frequently springing up in flower-pots in green-houses. In his own attempts to raise plants from antheridium-spores, Dr. Müller in every case failed. He does not deny, however, that they may be capable of germination, especially as some Lycopodiaceæ appear to be devoid of oophoridia.

In 1849 appeared M. Hofmeister's notice on the fructification and germination of the higher Cryptogamia.‡ in which he indicated the existence on the pro-embryo of *Selaginella*, of a number

* Das Wesen der Farrenkräuter. Leipzig, 1827.

† Ubers. der Arbeiten und Veränd. der schlesischen Gesellsch. für vaterl. Kultur, 1841 und 1845.

‡ Bot. Zeitung, Nov. 9, 1849.

of peculiar organs, composed of four papilliform cells, enclosing a large globular cell in the centre. In one of these large spherical cells the young plant is produced. The nature of the structure was only briefly described in this paper for the purpose of showing its analogy with what occurs in *Salvinia*.

In 1850, Dr. Mettenius* published an essay on the Propagation of the Vascular Cryptogams, and in this is to be found a full description of the organs mentioned by Hofmeister and altogether overlooked by Dr. C. Müller. According to this author, the large spores of *Selaginella involvens* possess two coats, each composed of two layers; and in an early stage of the germination, the inner layer of the outer coat, together with the inner coat, form the walls of a globular body which does not wholly fill the cavity enclosed by the outermost membrane. This globular body is firmly attached to the outer membrane immediately under the point of junction of the three ridges separating the flattened surfaces of the inner side of the spore. The globule enlarges until its walls come to be applied closely to the outer layer, completely filling up the large cavity. Then between the two layers of the inner coat, at a point immediately beneath the point of junction of the three external ridges, a process of cell-formation commences, producing a flattened plate of tissue interposed between the two layers; this structure is the pro-embryo. The cells are at first in a single layer, but the central ones soon become divided by horizontal septa so as to produce a double layer, and finally four or more tiers of cells one above another. The outline of the pro-embryo, seen from above, is circular, spreading over the upper part of the spore. On its surface appear the so-called ovules. The first is produced at the apex of the pro-embryo, the rest, to the number of twenty or thirty, arranged upon its surface in three lines corresponding to the slits by which the outer coat of the spore bursts. These ovules, closely resembling those of *Salvinia*, *Pilularia*, the Ferns, &c., consist of a globular cell surmounted by four cells, which rise up into four papillæ, and leave a canal or intercellular passage between them, leading down to the globular cell or embryo-sac. The four cells are usually developed into four or five cells, one above the other, by the production of horizontal septa; sometimes they are developed unequally and to a considerable extent so as to form papillæ, presenting an orifice between them at some point on the outer surface, indicating the canal leading down to the embryo-sac.

During the development of the ovules, a delicate parenchyma is produced in the great cavity of the spore, finally entirely filling up this spore. Before it has completely filled it, the embryo makes its appearance in the embryo-sac of one of the ovules.

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* Beiträge zur Botanik. Heidelberg, 1850.

The first change in this sac is the appearance of a nucleus; from this cells are developed representing the suspensor of the embryo. The cells of the suspensor multiply and form the process which penetrates down into the parenchyma of the cavity of the spore; at the lower end may be detected the embryo, a minutely cellular body. Dr. Mettenius never saw the embryo produced in the embryo-sac before the suspensor had broken through the bottom of it to penetrate the parenchyma of the spore-cell; it was always within this parenchyma and attached to the end of the suspensor. In this point he is decidedly opposed to Hofmeister, who states that the embryo originates in the embryo-sac, whence a young embryo attached to its suspensor may easily be extracted from the spore.

The part of the embryo opposite to the point of attachment of the suspensor corresponds to the first axis of the Rhizocarpeæ, which never breaks out from the spore-cell in *Selaginella;* it pushes back the loose parenchyma of the spore-cell as it becomes developed, and when completely formed, is surrounded by a thin coat composed of several layers of the parenchymatous cells much compressed, enclosed in the still existing inner coat of the spore. On one side of the point of attachment of the suspensor the embryo grows out towards the point where the spore-cell has been ruptured, thus apparently in a direction completely opposite to the end of the axis. As it enlarges it produces in this situation the leafy stem growing upwards, and the adventitious root turning downwards. The pro-embryo is at first distended like a sac, and finally broken through on the one side by the first leaf, on the other by the adventitious root; upon it may be observed the numerous abortive ovules, with their embryo-sacs filled with yellow contents; part of its cells grow out into radical hairs. Dr. Mettenius several times saw two young plants produced from one spore; the ends of their axes lay close together, and separated inside the cavity of the spore. No account is here given of the characters exhibited by the small spores, or of anything like a process of fertilization; yet we have indicated in the foregoing description of the so-called ovules, a clear analogy between these bodies and the so-called ovules of the Ferns and Rhizocarpeæ. These points will be referred to again at the close of the report.

In a review of Dr. Mercklin's essay on the reproduction of the Ferns, in the Flora,* Hofmeister states that spiral filaments are produced from the small spores of *Selaginella*, but does not state that he has seen them, or give any authority.

Isoëtaceæ.—The spores of the *Isoëtes lacustris* are of two kinds, analogous to those of the Lycopodiaceæ; both kinds being produced in sporangia imbedded in the bases of the leaves, but the

* Flora, 1850, p. 700.

large spores are found in great numbers, not merely four in a sporangium as in the Lycopodiaceæ. The development of the spores was little known until the publication of an essay on the subject in 1848, by Dr. C. Müller,* forming a sequel to his researches on the Lycopodiaceæ. Here, as in the other case, his observations on the earlier stages were imperfect; but he indicated the existence of the structures which have since been recognized as the so-called ovules; as also did Mr. Valentine† in his essay on *Pilularia*.

In his essay Dr. C. Müller compares the complete large spore, as discharged from the sporangium, with the ovule of flowering plants; and he describes it as a globular sac enclosed by three coats, which he names the primine, secundine, and the nucleus. The outermost coat, or primine, is stated to be composed of a thick cellular membrane exhibiting a raised network of lines, which give it the aspect of a cellular structure, but are in reality analogous to the markings on pollen-grains. The outer surface exhibits the lines indicating the tetrahedral arrangement of the spores in the parent cell, as in *Selaginella*, and it is at the point of intersection of these that the membrane gives way in germination. The next coat, or secundine, is another simple membrane lining the first. The nucleus is a coat composed of delicate parenchymatous cells, but among these are found groups of a peculiar character. These are described as consisting of a large cell divided by two septa crossing each other at right angles, projecting from the general surface, being either oval in the general outline, or having four indentations opposite the cross septa, so as to give the appearance of the structure being composed of four spherical cells. The cells surrounding them are of irregular form, different from the generally six-sided cells of the rest of the nucleus. Many of these groups occur on the nucleus, always at the surface of the coat where the primine and secundine afterwards give way, scattered without apparent order over it, but one always near the point of the opening. To these structures Dr. Müller did not attribute any important function, explaining them merely as produced by peculiar thickenings of the tissues to protect the proembryo during germination. The contents of the nucleus were stated to resemble those of the cavity of the spore of *Selanginella*.

In these contents, which become dense and mucilaginous, a *free* cell is developed near the upper part of the cavity; this is the rudiment of the embryo, and by cell-multiplication becomes a cellular mass, which soon begins to exhibit growth in two directions, producing the first leaf and the first rootlet, projecting from a lateral cellular mass, which the author calls the "reservoir of

* Botanische Zeitung, April and May, 1848; Annals of Nat. History, 2nd ser. vol. ii, 1848.

† Linnæan Transactions, vol. xvii.

nutriment." The embryo then breaks through the coats; the first leaf above and the first root below, the coats remaining attached over the central mass of the embryo. The subsequent changes need not be mentioned here, further than to state that the leaves succeed each other alternately, and are not opposite as in the Lycopodiaceæ; moreover no internodes are developed between them, so that the stem is represented by a flat rhizome, like the base of the bulb of many Monocotyledons.

In the paper by Dr. Mettenius,* already alluded to, we find some very important modifications of, and additions to, this history of development of the spores of *Isoëtes*, bringing them into more immediate relation with the other vascular Cryptogams.

This author describes the spore-cell as a thick structure composed of several layers; in some cases he counted four. It completely invests the pro-embryo, which is a globular cellular body filling the spore-cell. Among the cells of the outermost layer of the pro-embryo (which layer forms the *nucleus* of Dr. Müller), on the upper part, are produced the ovules, fewer in number than in *Selaginella*, arranged in three rows converging upon the summit of the spore, these rows corresponding to the slits between the lobes of the outer coat of the spore. The four superficial cells of the ovules (which are evidently the peculiar groups mentioned by Müller and previously noticed by Valentine)† grow much in the same way as in the Rhizocarpeæ and in *Selaginella*, into short papillæ. The embryo is developed in the substance of the pro-embryo, displacing and destroying its cells, and a globular portion (corresponding to the "reservoir of nutrition" of Müller) remains within the spore after the first leaf and rootlet have made their way out. This body is the analogue of that portion of the embryo of *Selaginella* which penetrates into the cavity of the spore, and to the end of the first axis in the Rhizocarpeæ.

The most important point, however, of Dr. Mettenius's researches relates to the phenomenon exhibited by the small spores. In the water in which the spores were sown he observed moving spiral filaments resembling those of the Ferns. He was not able to trace all the stages of development of these spiral filaments from the small spores, but he obtained nearly all the evidence relating to their origin which Nägeli has done in reference to the similar organs in the *Pilularia*.‡ In the small spores minute vesicles are produced of varying size and number, seen through the outer coat. The inner coat or spore-cell breaks through the outer coat either in the middle or at both ends at the projecting ridges, by which they are originally in contact with the other spore-cells. Its contents are expelled, as is proved by finding numerous empty membranes. The expelled vesicles are met with

* Beiträge zur Botanik. Heidelberg. 1850. † Linnæan Transactions, vol. xvii.
‡ Zeitschrift für Wiss. Botanik, Heft 3. Zurich, 1846.

in considerable number in the water, and contain one large or several small granules, and in them the spiral filaments are apparently produced; but the actual course of development was not observed. In one case a spiral filament was seen half way out of the spore-cell in active rotation, finally emerging completely, so that the moving spiral filaments are probably developed in the vesicles, while these are still contained within the spore-cell.

No actual connection of these moving spiral filaments or spermatozoa with the so-called ovules has yet been traced.

Rhizocarpeæ.—Almost from the earliest period of the study of Cryptogamous plants, attempts have been made to prove the existence of distinct sexes in the Rhizocarpeæ, various parts of the structure being regarded by different authors as analogues of the stamens and pistils of flowering plants. Bernard de Jussieu* went so far as to class them (*Pilularia glob.* and *Marsilea quad.*) with the Monocotyledons, with *Lemna*, considering the large spore-sacs as pistils and the small ones as stamens.

Others have sought the male organs in the hairs upon the leaves or receptacles;† but the rest of the numerous authors who have written on the subject, have either denied the distinction of sexuality altogether, or are agreed in considering the large spores as either ovaries or ovules, the small spores as pollen-grains. Experiments have frequently been made upon the generative powers of the two kinds of spores. Paolo Savi‡ found that the large spores of *Salvinia* would not germinate alone, and therefore he regarded the small ones as anthers. Duvernoy,§ on the contrary, states that he saw the large spores of *Salvinia* germinate when separated from the small ones, and therefore he did not regard the latter as anthers, but only rudiments. Bischoff,‖ who minutely described the structure of the European species, said that in his experiments the large spores of *Salvinia* germinated as well without the small granules as with them. Agardh¶ saw the large spores of *Pilularia* germinate separately, but later than those united with the anthers. Pietro Savi** made careful observations on the germination of the separated large spores of *Salvinia*, and found them to produce a green mamilla which underwent no further development; he therefore regarded the small spores as necessary for impregnation. Esprit Fabre†† carefully experimented on *Marsilea Fabri*. The separated large spores did not germinate; they did not even produce the stationary green papilla observed in *Salvinia* by Pietro Savi. Dr. C. Müller‡‡ found that the large spores of *Pilularia* would not germinate when separate from the small ones.

* Hist. de l'Acad. Roy. des Sc., 1739 and 1740.
‡ Biblioth. Italian, xx.
‖ Nova Acta xiv. and Cryptogam Gew., part 2, 1828.
¶ De *Pilularia* diss. 1835.
†† Ann. des Sci. Nat., 1837.
† Micheli, Linnæus and Hedwig.
§ Dis. de *Salv. nat.* &c., 1825.
** Ann. des Sci. Nat., 1837.
‡‡ Flora, 1840.

The development of the spores and the germination of the larger kind in *Pilularia* appear to have been first accurately described by Mr. Valentine,* in a paper read before the Linnæan Society in March, 1839. It is unnecessary to enter into the particulars of this paper, which gives accurate statements in most points, and mentions for the first time the occurrence of the cellular papilla upon the pro-embryo which has since been regarded as the "ovule," analogous to that found on the pro-embryo of the other vascular Cryptogams.

Dr. C. Müller's† essay appeared in 1840, and agrees in some points; but he appears to have mistaken the mode of origin of the pro-embryo. In 1843, Schleiden‡ announced that he had observed a process of impregnation in *Pilularia*, in which the small spores acted the part of pollen-grains, producing tubes which entered into a cavity on the surface of the large spore or "ovule," and, in accordance with his views of impregnation in general, became the embryo.

The next paper on the subject was an essay published by Dr. Metteniusş in 1846, in which the anatomy and development of *Salvinia* is treated at length; that of *Pilularia* and *Marsilea* less perfectly. He did not observe the process of impregnation described by Schleiden, yet from the want of organic continuity between the embryo and the "ovule," he inclined to adopt the theory of fertilization propounded by Schleiden, both for the Phanerogamia and the Rhizocarpeæ, namely, that the end of the pollen-tube penetrated into the so-called ovule and became the embryo; nevertheless he had some doubts, since he could not reconcile the production of "pollen-tubes" from the small spores of *Salvinia* with the facts he had observed, and never saw the "tube" penetrate the "ovule" in *Pilularia*.

In 1846, Prof. Nägeli published some new and important observations on *Pilularia*.‖ in which he stated that the observations of Schleiden were altogether incorrect, and that the bodies which that author had described as three or four "pollen-tubes," produced by the small spores and adherent to the summit of the large spore, were in fact parts of this, constituting a papilliform structure, forming a part of the pro-embryo developed by the large spore itself. Moreover he discovered a totally unexpected fact in regard to the small spore or "pollen grains." He found that these, without coming in contact with the large spores at all, became elongated by the inner coat protruding like a short pouch-like process through the outer. This contained starch-granules; and some he found burst and surrounded by starch-grains exactly

* Linnæan Transactions, vol. xvii. † Flora, 1840.
‡ Grundz. der Wiss. Botanik, 1843.
ş Beiträge zur Kenntniss der Rhizocarpeæ. Frankfort, 1846.
‖ Zeitschrift für Wiss. Botanik. Heft 3, 4, 188, 1846.

like those inside the others; and in addition to these, minute cellules which seem to have been expelled from the small spores. In these cellules were developed spiral filaments exhibiting active movement, just like those of *Chara*, the Mosses, &c. These filaments finally make their way out and swim about freely in the water. They were constantly met with in the gelatinous mass in which the spores were enveloped.

In 1849, M. Hofmeister* published an essay on the higher Cryptogams already alluded to, and there briefly described his own critical observations, referring to the points of difference from his predecessors. His statements are as follows:—

"The publications of Mettenius and Nägeli, as also those of Schleiden himself, sufficiently show that the large spores of the Rhizocarpeæ (the organs called by Schleiden 'seed-buds' [ovules]) originate essentially in the same way as the spores of the Cryptogamia generally, and as the small spores of the Rhizocarpeæ ('pollen-grains' of Schleiden) in particular. One young spore in each *sporangium* becomes developed more rapidly than the others, and finally usurps the whole cavity. At the time when the spores are ripe, a large spore does not differ from a small one in any respect except in dimensions (the size of the organs allows of the structure of the outer secreted layer being very distinctly observed; in *Pilularia* five layers can be clearly detected). The large spore is a simple tough-walled cell filled with starch or oil-drops and albuminous matter, enclosed by a thick *exine*, which, at the point when the 'sister-spores' were in contact with the developed spore in the earlier stages, exhibits peculiar conditions of form, displaying, according to the generic differences, a splitting into thin lobes or a considerable thinning of the mass. Not the least trace of the cellular body (the pro-embryo, *papilla of the nucleus* of Schleiden) is to be seen at this point at the time when the spores are just ripe.

"After the ripe spores have lain a longer or shorter time in water, a process of cell-formation commences at that point of the spore, *within* the proper, internal spore-cell, whence results the formation of a cellular body occupying only a small portion of the internal cavity of the spore. The cells multiply rapidly, and break through the *exine*, appearing externally as the green cellular papilla called the '*keim-wulst*' by Bischoff, the 'papilla of the nucleus' by Schleiden. I see no ground why this should be named otherwise than as the *pro-embryo*. In *Pilularia* it is very soon seen, where the pro-embryo consists of only about thirty cells, completely enveloped in the *exine*, and where the only external evidence of its existence is a little protuberance,—that the pro-embryo consists of a large central cell surrounded by a simple

* Botanische Zeitung, vol. vii, 1849; Botanical Gazette, vol. vii, 1850.

layer of smaller ones. The smaller cells covering the apex of this large cell, four in number, elongate into a papilla before the pro-embryo bursts through the *exine*, which splits regularly into twelve to sixteen teeth;—subsequently they become divided by horizontal walls, and then appear as the organ which Schleiden, and after him Mettenius, supposed to be 'pollen-tubes' produced from some of the small spores. These papilliform cells most certainly originate from the pro-embryo, a fact which takes away all material ground from Schleiden's theory.

"The four papilliform cells separate from each other and leave a passage leading to the large central cell. In this cell the young plant originates shortly after the smaller spores, which *never* produce 'pollen-tubes,' begin to emit the cellules containing spiral filaments discovered by Nägeli. I observed and dissected out an embryo consisting of only four cells. It completely filled the large central cell, and there was not the least trace of a pollen-tube attached to it.

"The organization of *Salvinia* is somewhat different from this. On every pro-embryo, several, as many as eight, cells of the outer surface of the cellular layer next but two to the obtuse triangular cellular body, acquire a considerable size, a spherical form, and become filled with protoplasm; the four cells covering each of these larger cells lose the greater part of their chlorophyll and separate from each other to leave a passage leading down to the large central cell. In this large cell the young plant originates. The number of these organs in *Salvinia* allows the possibility of the occurrence of poly-embryony in this genus; I observed two embryos on one pro-embryo in one case.

"It is out of the question to talk of a 'larger pollen-tube' in *Salvinia*. Mettenius has already shown that the structure of the small spores renders such a product from them impossible."

Dr. Mettenius's Essay on the Vascular Cryptogams,* already frequently referred to, confirms the preceding account in all essential points, some slight criticisms relating only to the structure of the coats of the spore; and it adds a description of the development of the 'ovules' in the pro-embryo of *Marsilea Fabri*, which agrees closely with that in *Pilularia*. Hofmeister† has recently announced the discovery of the production of cellules containing spiral filaments from the small spores in *Salvinia*, just as Nägeli saw them in *Pilularia*.

General Conclusions.

In the facts of which I have given confessedly a very imperfect *résumé* in the preceding pages, we have two important points to consider. In the first place, we have to determine how far

* Beiträge zur Botanik. Heidelberg, 1850.

† Flora, 1850, p. 700 (in a note to a review of Mercklin's Essay on the Reproduction of Ferns).

they suffice to warrant the belief in the existence of a distinction of sexes in these families. In the second place, we have to endeavor to trace the analogies which exist between the different conditions presented by the supposed sexual organs in the different families. These considerations, if we adopt the hypothesis of sexuality, lead to some very interesting questions in reference to the process of reproduction generally.

In regard to the first question, that of the existence of two sexes and the necessity of a process of fertilization, we have several kinds of evidence.

1. The inferences to be deduced from the universality of the existence of two kinds of organs in connection with the reproductive process. We have seen that these exist in all the families at some period or other of the life of the representative of the species. In the Mosses and the Hepaticæ they occur in the fully developed plant. In the Ferns and Equisetaceæ they occur upon cellular structures of frondose character developed from all the spores, which frondose bodies or pro-embryos have an existence of some permanence, especially in the Equisetaceæ. In the Lycopodiaceæ, the Isoëtaceæ and Rhizocarpeæ, the pistillidia occur upon very transitory cellular structures produced from one kind of spore, the larger; while the smaller spores at once develop in their interior cellules containing moving spiral filaments, such as occur in the antheridia of the other families.

2. The inferences to be deduced from the observations on the development of those plants in which the two kinds of organs, occurring in distinct places, can be separated. Strong evidence has been brought forward that the diœcious Mosses, as they are called, do not produce sporangia when the pistillidia are kept apart from the antheridia by natural accident. The majority of observers state that the large spores of the Rhizocarpeæ do not germinate if the small spores are all removed from contact with them; a few counter-statements however do exist. Again, the majority of authors, and all the recent ones, state that only the large spores of the Lycopodiaceæ and Isoëtaceæ produce new plants; while some older writers believed that they had seen the small spores do so.

3. The direct observation of a process of fertilization, of which we have only testimony from two authors, Suminski and Mercklin, in reference to the Ferns alone; since the assertions of Schleiden in regard to the Rhizocarpeæ have been demonstrated by Nägeli, Hofmeister and Mettenius to have been based on very imperfect observation.

The circumstantial evidence furnished under the first head seems to me very strong, so much so that I am inclined to adopt the idea of sexuality on this ground as the legitimate provisional hypothesis arising out of our present knowledge, especially when

supported so strongly as it is by the negative evidence indicated under the second head.

The positive evidence of the third head is certainly very insufficient as yet, considering the extreme delicacy of the investigation. Suminski's other observations on the details have been contested in many particulars; and Mercklin, the only other observer who asserts that he has seen the spiral filaments within the so-called ovules, describes the conditions differently, and states that he has only been able to observe them positively there three times. At the same time the difficulty of the investigation should make us hesitate in attaching too much weight to the failure of the other observers in tracing a process of fertilization; moreover it is quite possible that actual entry of the spiral filaments into the canal of the ovules or pistillidia is not always, if ever, necessary.

The facts before us, then, appear to me strong enough to warrant the adoption of the views propounded by the latest authors on this subject, and the acceptance of the hypothesis of sexuality in the Vascular Cryptogams as the most satisfactory explanation of the phenomena as yet observed. The question lies now much in the same condition as that of the sexuality of flowering plants before the actual contact of the pollen-tubes with the ovules had been satisfactorily demonstrated.

Further arguments may be adduced from grounds lying out of the preceding statements, viz. 1. The late discovery of two forms of organs in the Algæ, Lichens and Fungi, which, although imperfect at present, lead to the expectation that the analogues of the antheridia and pistillidia of the Mosses, so long known, will be found in all Cryptogamous plants. 2. The analogies between the processes of animal and vegetable reproduction which appear to be offered by these new views of the nature of the phenomena in the Vascular Cryptogams. To this last argument I shall merely allude, as it may be considered to lie beyond the special province of the vegetable physiologist; yet when we recollect the imperceptible character of the gradations of the lower forms of the two kingdoms, there seems far sounder ground than is allowed by Schleiden for arguing from apparent analogies between the phenomena occurring in the two great kingdoms of nature.

Under the second point of view mentioned above, the facts of structure may soon be disposed of, so far as the analogies of form are concerned; the antheridia of the Mosses, Hepaticæ, Ferns, and Equisetaceæ agree with the small spores of *Isoëtes*, *Selaginella*, *Pilularia*, and *Salvinia* in producing the cellules in which are developed the moving spiral filaments which constitute the essential character of the organs of the one kind; while the pistillidia of the Mosses and Hepaticæ agree with the so-called "ovules" of the Ferns, Equisetaceæ, Lycopodiaceæ, Isoëtaceæ, and Rhizocarpeæ, in general structure and in the presence of the central large cell from which the new form of structure originates.

The great differences depend on the position in time and space of the organs, in the different classes, and the nature of the immediate product of the so-called "embryo-sac," the large central cell of the pistillidia and "ovules."

In the Mosses and Hepaticæ the pistillidia occur upon the plant when the vegetative structure is perfect,—and the immediate product of the great cell is a sporangium. If a process of fertilization takes place here, we may regard the antheridia and pistillidia as analogues of the anthers and pistils of flowering plants; the sporangias of their fruits; or with Hofmeister we may regard the phenomena as an instance of an "alteration of generations," where the pistillidium would be looked upon as an ovule, producing (in the sporangium) a new individual of totally different character from that developed from the spore (the leafy moss plant in the usual acceptation of the term).

In the Ferns and Equistaceæ, we find the spores producing a frondose structure of definite form, upon which are developed antheridia and pistillidia or "ovules." Here then we seem to have one generation complete, and the new development from the pistillidium or "ovule" appears in a totally new form, producing stem and leaves which have a distinct individual form and existence, and produce the spores after a long period upon temporary parts of the structure, on the leaves; and by no means cease to exist when those are matured. Here we seem to have a real "alternation of generations," and Hofmeister compares the whole permanent plant of the Fern or *Equisetum* to the sporangium of the Mosses and Hepaticæ. In all the other families, the Lycopodiaceæ, Isoëtaceæ, the Rhizocarpeæ, the pro-embryo is a very transitory production, and is developed from a different spore from the spiral filaments. This pro-embryo is clearly analogous to that of the Ferns and Equisetaceæ; and if the existence of sexes be a fact, we have here a dœcious condition as contrasted with a monœcious condition in the two last-named families. Hofmeister here again assumes that the pro-embryo developed from the large spore is an intermediate generation between the two perfect forms of the plant.

It is rather difficult to decide upon the real analogies of these structures with those of the flowering plants. The resemblance of structure is so close between the pistillidia of the Mosses and Hepaticæ, and the "ovules" of the other Vascular Cryptogams, that they must be regarded as analogues, and then the former could not well be conceived to be analogous to the pistils of flowering plants, but rather to ovules; if this be the case, the sporangium must be considered the analogue of the perfect plant in the Fern, &c., and the leafy stem as the analogue of the pro-embryo of the Ferns, &c. The pistillidium of the Mosses can indeed hardly be regarded as analogous to the fruit of a flowering plant,

as in that case the spores would be ovules produced long after fertilization; and on the other hand, if we consider the pistillidia of the Moss as an ovule, which it might be, analogous to that of the Coniferæ,—in which a large number of embryonal vesicles or rudiments of embryos are produced after fertilization on the branched extremities of the suspensors,—then we seem to lose the analogy between the product of the pistillidium of the Moss and that of the ovule of the Fern, unless we would regard the entire plant of a perfect Fern as analogous to the ovule of a Conifer.

Perhaps the time has hardly come for us to arrive at any conclusion on these points. The phenomena in the Ferns and Equisetaceæ, as well as in the Rhizocarpeæ, Lycopodiaceæ, and Isoëtaceæ less strikingly, seem to present a series of conditions analogous to those which have been described under the name of "alternation of generations" in the animal kingdom, and seeing the resemblance which the pistillidia of the Mosses have to the ovules of the other families, we can hardly help extending the same views to them; in which case we should have the remarkable phenomenon of a compound organism, in which a new individual forming a second generation, developed after a process of fertilization, remains attached organically to the parent, from which it differs totally in all anatomical and physiological characters. It is almost needless to advert to the essential difference between such a case and that of the occurrence of flower-buds and leaf-buds on one stem in the Phanerogamia, as parts of a single plant, yet possessing a certain amount of independent individuality. These are produced from each other by simple extension, a kind of gemmation; while the Moss capsule, if the sexual theory be correct, is the result of a true *reproductive* process.*

In conclusion, I may remark, that these anomalous conditions lose their remarkable character to a great extent if we refuse to accept the evidence of sexuality which has been brought forward here. If the structures are all products of mere extension or gemmation, the analogies which have been supposed to exist between them and the organs of flowering plants all fall to the ground. But believing that the hypothesis of sexuality is based on solid grounds, I am by no means inclined to allow the difficulty of the explanation of these relations to be urged as a valid argument against their existence, and I trust that this imperfect report may be the means of attracting new investigators to a sub-

* Moreover we have analogy to the increase by buds in the *innovations* by which the leafy stems of the Mosses are multiplied, both in the earliest condition, where a number of stems are developed from the byssoid mass produced by the spore, and afterwards by gemmæ on the stems and leaves, as in the Liverworts also. The byssoid mass produced by the Moss-spore has usually been called the *pro-embryo*, but it is evidently not analogous to the bodies termed pro-embryos in the Ferns, Lycopodiaceæ, &c., &c. It would almost seem to constitute a third member of a series of generations.

ject which presents so many points of interest and importance.—*July 3rd*, 1851.

Postscript.—Since the above Report has been in print, Dr. W. Hofmeister has published his promised work upon the higher Cryptogams,* which contains an elaborate series of researches upon this subject. He there confirms all his previous statements, and all the essential particulars given by Suminski, Nägeli, Mettenius, &c., excepting the *facts* of the impregnation by means of the spiral filaments or spermatozoids, which however he considers it warrantable to *assume*. His speculations as to the relation of the Conifers to the Lycopodiaceæ, as shown by the development of the embryo, are very interesting. We can only claim space to indicate the general results of his work as given in the concluding summary:—"The comparison of the course of development of the Mosses and Liverworts on the one hand, with the Ferns, Equisetaceæ, Rhizocarpeæ and Lycopodiaceæ on the other, reveals the most complete agreement between the development of the fruit of the former and the development of the embryo of the others. The archegonium of the Mosses, the organ within which the rudiment of its fruit is formed, resembles perfectly in structure the archegonium of the Filicoids, (in the widest sense,) that part of the prothallium in the interior of which the embryo of the frondescent plant originates. In the two great groups of the higher Cryptogams, one large central cell originating free in the archegonium, gives origin by repeated subdivision to the fruit in the Mosses, and to the leafy plant in the Filicoids. In neither of them does the subdivision of this cell go on, in both does the archegonium become abortive, if spermatic filaments do not reach it at the epoch when it bursts open at the apex.

"Mosses and Filicoids thus afford one of the most striking examples of a regular alternation of two generations widely different in their organization. The first of these, produced by the germinating spore, develops antheridia and archegonia, sometimes few, sometimes many. In the central cell of the archegonium, in consequence of a fertilization through the spermatozoids emitted from the antheridia, becomes developed the second generation, destined to produce spores, which are always formed in a number much greater than that of the rudimentary fruits of the first generation.

"In the Mosses the vegetative life is exclusively committed to the first, the production of fruit to the second generation. Only the leafy stem possesses roots; the spore-producing generation

* Vergleichende Untersuchungen der Keimung, Entfaltung und Fruchtbildung höherer Kryptogamen (Moose, Farrn, Equisetaceen, Rhizocarpeen und Lycopodiaceen) und der Samenbildung der Coniferen. 1851, Leipsic, Hofmeister, 4to, pp. 180, tt. 33.

draws its sustenance from the foregoing. The fruit is usually of shorter duration than the leaf-bearing plant. In the Filicoids the opposite condition obtains. It is true the prothallia send out capillary rootlets; those of the Polypodiaceæ and Equisetaceæ under all circumstances, those of the Rhizocarpeæ and Selaginellæ frequently. But the prothallium has a much briefer existence than the frondescent plant which in most cases must vegetate for several years before it comes to bear fruit. Yet the contrast is not so strong as it appears to be at first sight. The seemingly unlimited duration of the leaf-bearing moss-plant depends upon constant renovation (*verjüngung*). Phenomena essentially similar occur in proliferous prothallia of the Polypodiaceæ and Equisetaceæ. The structure of the lowest Mosses (*Anthoceros*, *Pellia*) is less complex, and the duration of the fruit-bearing shoots is little longer than that of the fruit itself. On the other hand, the ramification of the prothallium of the Equisetaceæ is exceedingly complicated; its duration is even equal to that of a single shoot.

"It is a circumstance worthy of notice, that in the second generation of Mosses, as of the Filicoids, destined to produce spores, more complex thickenings of the cell-walls regularly occur (teeth of the peristome of Mosses, wall of capsule and elaters of Liverworts, vessels of Filicoids, &c.,) while in the first generation, springing from the spores, such structures are found only rarely and as exceptions.

"The manner in which the second generation arises from the first, varies much more in the Filicoids than in the Mosses. The Polypodiaceæ and Equisetaceæ are hermaphrodite; the Rhizocarpeæ and Selaginellæ monœcious. All the Filicoids agree in the fact that the first axis of their embryo possesses but a very limited longitudinal development; that it is an axis of the second rank which breaks through the prothallium and becomes the main axis; further, in the end of the axis of the first rank never becoming elongated in the direction opposite to the summit. All Filicoids are devoid of a tap-root, and possess only adventitious roots.

"In more than one respect does the course of development of the embryo of the Conifers stand intermediately between those of the higher Cryptogams and the Phanerogams. Like the primary parent-cell of the spores of the Rhizocarpeæ and Selaginellæ, the embryo-sac is an axile cell of the shoot, which in the former is converted into a sporangium, in the latter into an ovule. In the Conifers the embryo-sac also very early becomes detached from the cellular tissue surrounding it. The filling-up of the embryo-sac with the albumen may be compared with the origin of the prothallium in the Rhizocarpeæ and Selaginella. The structure of the 'corpuscula' bears the most striking resemblance to that of the archegonia of *Salvinia*, still more to that of the Selaginellæ.

If we leave out of view the different nature of the impregnation, in the Rhizocarpeæ and Selaginellæ by free-swimming spermatic filaments, in the Coniferæ by a pollen-tube (which *perhaps* develops spermatic filaments in its interior), the metamorphosis of the embryonal vesicle into the primary parent-cell of the new plant in the Conifers and Filicoids is solely distinguished, by the latter possessing only a single embryonal vesicle which completely fills the cavity of the central cell of the archegonium, while the former exhibits very numerous embryonal vesicles swimming in it, of which only one pressed into the lower end of the 'corpusculum' becomes impregnated. The embryo-sac of the Conifers may be regarded as a spore which remains enclosed in its sporangium; the prothallium which it forms never comes to light. The fertilizing matter must make a way for itself through the tissue of the sporangium, to reach the archegonia of this protallium.

"Two of the phenomena which led me to compare the embryo-sac of the Conifers with the large spores of the higher Cryptogams, are common also to the embryo-sac of the Phanerogams: the origin from an axile cell of the shoot, and the independence of the surrounding cellular tissue (so striking, for example, in the Rhinanthaceæ, through the independent growth of the embryo-sac). By their pollen-grains producing tubes the Conifers are closely connected with the Phanerogams, from which they differ so much in the course of development of their embryo-sac and the embryonal vesicles. The separation of the prothallium of the Conifers into a number of independent spensors, is a phenomenon of a most peculiar kind, having no analogue throughout the vegetable kingdom."—(*Loc. cit.* pp. 139–41.)—A. H. December 16, 1851.

Art. V.—*Review of Phillips's Mineralogy by Brooke and Miller.**

This new edition of Phillips's Mineralogy has for several years past been looked for with great interest. The name of Phillips is deservedly distinguished in British mineralogical science; and the addition of the labors of Brooke and Miller has seemed to promise a work of unusual merit. The copartnership proves however to be one in which the older author has no concern or rightful title; for scarcely a trace of the original labors of Phillips

* An Elementary Introduction to Mineralogy, by the late Wm. Phillips. New edition, with extensive alterations and additions, by H. J. Brooke, F.R.S., F.G.S., and W. H. Miller, M.A., F.R.S., F.G.S., Professor Min. Univ. of Cambridge. 700 pp., 12mo. London, 1852, Longman, Brown, Green and Longman.

remains: and even his figures of crystals and measurements, in which department he was especially eminent, have disappeared. The work has certainly lost in value by this rejection of all that Phillips could call his own, while at the same time it has gained a new importance from the able crystallographic labors of its present authors. There was also some ground for supposing that the work would be especially adapted for this continent as well as the other, in the fact that an edition of Phillips had been issued here by Alger. But Mr. Alger's name and book are hardly noticed through the volume.

The work has many peculiarities and certain defects, the mention of which is of some interest to American mineralogists and to the science. We propose therefore to run through its pages, briefly touching upon such points as will exhibit its character in a just light.

The first 50 pages are devoted to Crystallography. The system adopted is that of Prof. Miller. The subject is presented in an abstract mathematical form, with few explanations of the general principles and laws for the occurrence of secondary planes, and without any illustration of the distortions to which crystals are subject. The names adopted for the six systems of crystallization, are the *cubic*, *pyramidal*, *rhombohedral*, *prismatic*, *oblique*, and *anorthic*. Figures are given in the descriptive part of the work, illustrating the crystallization of the species. These figures, however, with rare exceptions, are simply plans, or views in the direction of one of the axes, usually the vertical. They are drawn with precision and are excellent as far as they go. But they are not portraitures of crystals, and give no sufficient idea of the prevailing forms. Augite, zircon, anatase, for example, have each a crystallographic physiognomy easily recognized. But from these plans, the student has no way of arriving at a knowledge of this physiognomy or of ascertaining the actual character of a crystal, since the length cannot by any powers of conception or study be deduced. An octahedron thus represented is not distinguishable from an elongated prism with pyramidal terminations, nor a scalenohedron or a rhombohedron from a terminated six-sided prism. The figures under calc spar are examples to the point.

Besides these plans, which are seldom more than two to a species, there is a large circle marked with dots, which exhibits in an ingenious manner the positions of the faces of all known crystals of the species. These circles, however, hardly convey any information not implied in the mathematical symbols of the planes, which to some extent are also given. There is, besides, a system of letters, not for the figures, but for designating and describing secondary forms. For example, under Realgar (p. 177) the occurring combinations of secondary planes are described as

follows: *cm, cmrl, xrml, crmle, crmleb, crmltzab, nrceqfmwlvab, xnezucrfmwvab.* A key to these letters is given in the earlier part of the work. Thus there are three modes of designating planes; one, by numbers, corresponding mainly in form, with Weiss's system, omitting the ratio sign, as 111, 012, 212, &c.; another, the system of letters, just alluded to; and the third, the dots. The first strikes us as the best, and, if slightly modified, as the only one required or needed. The others are perplexing to the student.

The authors have added very much to our knowledge of the crystals of species by their measurements and calculations, and in this, the great merit and value of the work mainly consist. With each species, a large number of angles is mentioned; these angles are those between normals (perpendiculars) to the faces, instead of those between the faces themselves.

The chapters on Refraction and Pleochroism are well drawn up, and the others on the Physical characters, though brief, are sufficient for the purposes of the Mineralogist.

Under the head of Chemical Constitution, a classification of the elements is given, in which, we judge, no attempt was made to present a view of the true chemical relations of the elements.

The idea that silica contains two of oxygen ($Si O^2$) instead of three ($Si O^3$), is adopted throughout the work in its chemical formulas, a view proposed a few years since by Gmelin, but generally rejected since the researches of Kopp. The authors also have made alumina to consist of 1 of aluminium to 3 of oxygen ($Al O^3$), while the peroxyd of iron and allied compounds have the ratio 2 : 3, ($Fe^2 O^3$, $Cr^2 O^3$), as is seen in the table on page 79, and afterwards through the descriptions of the species. This view of alumina is adopted by Rammelsberg in his recent publications, but not that of silica.

In the chapter on *Isomorphism*, a table, extracted principally, as stated, from Frankenheim's "System der Krystalle," presents a list of various isomorphous groups. This table might have been much extended by the results of later researches. For example, the isomorphism of calc spar, nitrate of soda, and dark red silver ore, and that of arragonite, nitrate of potash, and Bournonite, brought out by Rose are not recognized; neither the observations of Rammelsberg or Scheerer. A paper in this Journal, published in 1850,* besides others of more recent date, might have afforded additional facts bearing upon a branch of Isomorphism not alluded to.

* Vol. ix, 2nd Ser., p. 220.

A good chapter on the Chemical reactions of Minerals occupies from pages 85 to 100.

The descriptive part of the Treatise commences with the "*Metalloids*," sulphur, selenium, carbon; then follow the *Metals;* next the *Tellurides;* then in order the *Antimonides—Arsenides—Selenides—Sulphides—Oxyds, earths and acids—Hydrous oxyds, earths and acids—Silicates—Hydrous silicates—Tantalates, niobates, scheelates, molybdates—Arseniates, phosphates—Hydrous arseniates, phosphates—Sulphates—Hydrous sulphates—Chromates—Vanadiates—Sulphates with Carbonates—Carbonates—Hydrous carbonates—Nitrates—Borates—Fluorides, Chlorides, Bromides, Iodides—Resins, Coal.*

The descriptions are given with precision and sufficient brevity. The lists of localities are mostly mere lists of names, with seldom any mention of the associations of the species. As is natural, American localities are given less definitely than those of Britain or Europe, when not altogether forgotten. Of *Rutile*, it is said that it occurs in *North America*, certainly an important fact to the mineralogists of England, as well as to those of North America itself.

The analyses introduced are rather numerous, but no references are added to the Journals in which they were originally published; neither is there more than a single chemical formula given, although a species may be of doubtful composition, or, as in the case of Scapolite, it may actually include several compounds.

Along with the names of species in the heading preceding the descriptions, the names of certain mineralogists are usually mentioned. But it is remarkable that the old rule of giving an author credit for his work is set aside. Since the enactments of certain laws relating to nomenclature by the British Association, it has been supposed that in Britain at least, there was a high sense of delicacy on this point. But the authorities mentioned by Messrs. Brooke and Miller are often only the names of certain authors of Treatises, to the exclusion of those of original observers. Turning to *Gibbsite*, we find with some surprise, that the species is attributed to Phillips, and *Gibbsit* to Mohs, Hausmann, and Haidinger, and our friend Dr. Torrey is forgotten. *Cancrinite* of Rose is in the same way attributed to Hausmann; *Schorlomite* of Shepard to Rammelsberg; *Diaspore* is followed by "Phillips, Haüy," instead of "Haüy, Phillips." in their proper order; *Hornblende* is attended by the name of Phillips alone; *Apatite* is attributed to Phillips, and then *Apatit* to Hausmann, Haidinger, again. Such a use of names is calculated to mislead, unless understood to mean simply that this or that author has the name in his book, which is all that the authors could have intended, and which principle should have been somewhere announced.

Some species that were already abundantly supplied with names have been here supplied anew. Thus Copper pyrites, called also Chalcopyrite by Haidinger, passes under the new name *Towanite*. No reason is given for the change. Chalcolite (or Lime-Uranite) is named *Torberite*. Uranite (or Copper-Uranite) is *Autunite*. Atacamite or chlorid of copper appears as *Remolinite;* Azurite or Blue Malachite as *Chessylite*. These will suffice as examples.

Again, some German names are adopted in their German dress, and look queer enough in an English work. Such are *Antimonsilber*, in place of Antimonsilver, or Antimonial Silver; *Kupfernickel*, instead of Copper-Nickel, the thing in plain English. Names consisting of two words are repudiated by some mineralogists, and various are the shifts to avoid them:—just the reverse of the fact in other branches of Natural Science. Hence it is, apparently, that the word *Kupfernickel*, in which the two parts can be written together without a hyphen, is deemed preferable to *Copper-nickel*. It is probably on the same principle that Red Zinc Ore must give way, according to our authors, for *Spartalite;* and Copper Glance (from the German Kupferglanz) or Vitreous Copper, for *Redruthite*, a name, by the way, proposed by Nicol in his recent valuable work, although not so acknowledged in this edition of Phillips. So Magnetic Pyrites is made to yield to *Pyrrhotine;* Spathic Iron to *Chalybite;* Schiller Spar to *Bastite;* Specular Iron to *Hematite*, a word of most ambiguous signification in the science. For ourselves, we see no reason for this abhorrence of such names.

Eisennickelkies is another example of a foreign name accepted by our authors; and how is it better than iron-nickel-pyrites, which it signifies? or *Porzellanspath* than Porcelain-spar, a name already in use? Let the reader examine these words and pronounce each syllable considerately, and then judge how far science, sense, or taste, is benefitted by retaining in an English book the German orthography. Quite as good reason might be found, for a general substitution in Britain of the German for the English language. So also *Feuerblende* (p. 216); which the mineralogist, without a knowledge of German, would be likely to pronounce *Fewerblende*, while *Fireblende* represents closely, in fact, its pronunciation as well as meaning. Even Pyrites has lost an *s*, (after Haidinger,) and it stands *Pyrite*, a name hardly distinguishable from Pyrrhite, the designation of another species. The whims of authors thus tend to keep the synonymy of Mineralogy in a state of constant ferment.

The work of Messrs. Brooke and Miller has also its deficiencies. We should at least expect to find a full list of known species and known varieties, and also of current synonyms. The deficiency in the latter might be extensively illustrated. Thus

Heavy spar is not mentioned as a synonym of Baryte, (another new name,) and of course Heavy spar is not in the Index; *Bromlite* is not given as a synonym of Alstonite; *yenite* of Ilvaite; *manganese spar* of Rhodonite, etc.

There are also omissions of species and facts that are somewhat difficult of explanation. It will be of most interest to American mineralogists to learn of those that pertain to American minerals.

The species *Gibbsite*, found at Richmond, Mass., was first correctly analyzed and described, years ago, by Dr. Torrey. Hermann recently analyzed certain specimens from Richmond and reported their containing a large amount of phosphoric acid. This led to some careful analyses by Silliman, Jr., who proved that Dr. Torrey was right, no phosphoric acid, or but a trace, being detected. These results are published in Dana's Mineralogy, and in this Journal, volume vii, p. 411, (1849). Brooke and Miller mention only the analyses of Hermann, not even intimating that any different view is held by others, although Hermann's own results vary in the phosphoric acid from 37·6 to 11·9 per cent! Moreover, to add to the confusion, the Gibbsite locality, Richmond, is referred to as a locality of Hydrargillite as well as of Gibbsite, although it is well known that but one of these species occurs there.

Emerylite of Dr. J. Lawrence Smith has been found within the past three or four years to be a very common mineral, occurring with corundum in Asia Minor and Siberia, as well as in the United States, in North Carolina and Pennsylvania. There have been *six* analyses of American specimens by three different chemists;* also *eight* by Dr. Smith of the Asia Minor mineral, and *one*, by the same chemist, of a Siberian specimen. Dr. Smith's analyses are published in this Journal, Jan., 1851. All agree very closely. The authors of this new edition of Phillips throw the species into their Appendix, give a single analyses, and mention only the Pennsylvania and Asia Minor localities. But this is not all.

Early in 1851, (May,) Hermann published in Erdmann's Jour. für Prakt. Chemie,† a paper on Mica and Cordierite, in which he gives a new analysis of Margarite,—a mineral till then but imperfectly investigated. Hermann's result (unknown to himself, at the time) proves the identity of emerylite and margarite (a fact long before suspected by Dr. Smith and other American mineralogists, and recently partly ascertained by an unfinished analysis by Mr. G. J. Brush). The work before us has only the old erroneous analysis of Margarite, and does not recognize this new fact respecting Emerylite.

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* See Dana's Mineralogy, 3d edition, 1850, p. 362. † Vol. liii, p. 1.

Corundellite is another Appendix species; and a little more attention to published results would have banished it altogether. Both in this Journal two years since, and in Dana's Mineralogy, its identity with Emerylite is announced and a new analysis published. *Euphyllite* is in the same Appendix; but instead of giving the later results, published two years since in the works just alluded to—both certainly accessible works to the scientific enquirer—only the first incorrect analysis is introduced. The new analyses were made in the same laboratory with the first, an error in the early results having been suspected.

Warwickite, another Appendix species, is published with an analysis by Mr. T. S. Hunt, made in 1846, and no notice is taken of his new results published in this Journal in May, 1851, (xi, 352,) where the author gives a very different composition as to the proportions of the ingredients, and shows that the crystals before examined, although of the prevailing kind, had undergone alteration.

The greater part of *American* species are black-balled or have a place in the Appendix. The following are among the latter. *Boltonite*, *Danburite*, *Emerylite*, *Euphyllite*, *Warwickite*, *Liebigite*, *Emerald Nickel*, which are believed to be well established species, besides also others that are less well understood. Other species are rejected without any mention even among synonyms. Such are *Pennite*, *Phyllite*, *Williamsite*, *Microlite*, *Vermiculite*, *Chesterlite*, *Melanolite*, *Tungstic Ochre*, *Clinochlore*, *Melaconite*, *Dysyntribite*, *Rutherfordite*, *Paracolumbite*, *Houghite*, *Marasmolite*, *Calyptolite*, *Eumanite*, *Corundophilite*, *Ozarkite*, *Lederite*, *Medjidite*. Such a sweeping destruction of the enemy is certainly a great feat in Mineralogical tactics. We believe however that the authors have misjudged with regard to their readers, even supposing the species bad, which is undoubtedly true of several of them. The reference of the name of a bad species to the species to which it belongs, is conveying information which mineralogists value. A total rejection of published species and facts, which the authors have had no opportunity personally to study, does not show discrimination, mineralogical science, or an appreciation of the wants of mineralogists either in Europe, Britain, or America.

Again we observe that the important results of Dr. J. Lawrence Smith respecting Corundum, a paper read before the Academy of Sciences at Paris and published in this Journal (January, 1851,) are unnoticed. The species Phlogopite is not mentioned, nor the name alluded to. It is evidently referred to the species "Mica," by which is meant that kind of Mica sometimes called Oblique mica, and latterly by Dana, *Muscovite*, a name not recognized by Messrs. Brooke and Miller, nor admitted among synonyms.

We might pursue farther the list of delinquencies and extend it also to foreign species. As to the latter, there is less reason for complaint, although the work contains very little of what appeared in Europe in 1851. With regard to the former we think that American mineralogists have already been sufficiently amused and will appreciate their obligations to the authors, without more details. The book was probably intended for a certain class of English readers that do not consider American rocks or science within the range of British interests, and viewed in this light, its errors or deficiencies, are not more perhaps than were to be expected.

ART. VI.—*Description of the interior of the Cranium and of the form of the Brain of Mastodon giganteus;* by JEFFRIES WYMAN, M.D.

THE external configuration of the cranium of the Mastodon has been described by so many naturalists, especially by Cuvier, De Blainville, Godman, Hayes, Owen, and more recently by Warren, that little remains to be added to its descriptive anatomy. Its internal structure has however attracted but little notice comparatively, and in all probability but few instances, favorable for observation have occurred, the crania of Mastodons having been generally looked upon as too rare and valuable to warrant the risk of making sections or the necessary dismemberment of parts. In the collection of Mastodon bones discovered in Warren Co., New Jersey, in 1845, and now belonging to Harvard College, is the section of a cranium made under the direction of Dr. Warren and noticed in his recent memoir* on this extinct animal. From the perfect preservation of the bones and the care with which the section has been accomplished, an unusually good opportunity is afforded for studying its internal structure. In the memoir just referred to, Dr. Warren has for the first time given the diameters of the cranial cavity and described the fossæ in the base of the skull; the vast development of the diploic cells, and some of the foramina for the transmission of nerves, especially the foramen ovale, and Vidian canal, are also noticed. In plate 17 of his memoir is an excellent representation of the section of the cranium and face. The individual to which the skull above referred to belonged was obviously immature, as the ossification of some of the bones is not yet quite complete. The molar teeth are two in number on each side in each jaw and have each three ridges,

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* The Mastodon Giganteus of North America; by John C. Warren, M.D. Boston, 1852.

and were probably the third and the fourth of the dental series —the empty socket in front corresponding in size with the second two-ridged tooth.

Among the anatomical points of interest which have not as yet been especially described, are the number and proportional size of the foramina in the base of the skull; and the form of the brain as indicated by the configuration of the cranial cavity.

Olfactory foramina.—The cribriform plate on either side of the median lines is of a pyriform shape; it is about two and six-eighths inches in length by one and six-eighths in breadth, and is perforated by a large number of minute holes for the transmission of the filaments of the olfactory nerves. Of these openings one hundred and seventy-five were counted on one side. An opening larger than the rest exists at the upper part and serves for the exit of the nasal branch of the fifth pair of nerves.

The *Optic foramen* is vertically depressed having an elongated oval form; but as the optic canal recedes from the cranial cavity it becomes more nearly cylindrical, having a diameter of about three-sixteenths of an inch; the canal is directed upwards for the distance of seven inches when it reaches the orbit in the bottom of a deep channel.

The *Foramen lacerum of the orbit* is quite small, lies concealed beneath the anterior clinoid process, and is so much out of view that it would easily escape notice; it enters the orbit in the same channel with the optic nerve, but some distance below it.

In the cranium of an adult African elephant belonging to the Boston Society of Natural History, and which has served for the comparisons given in this notice, the foramen lacerum is more exposed within the cranium, and its outer opening is separated only by a thin septum of bone from that of the optic nerve—the canal for this last being much shorter than in the Mastodon.

The *Foramen rotundum* which transmits the second branch of the trigeminus nerve, is about one half of an inch in diameter, and occupies very nearly the position of the foramen lacerum of the orbit: in other animals it is only separated from this last by a thin bridge of bone; and this even no longer exists in some Ruminants, so that in these the foramen lacerum and rotundum are wholly blended.

The *Foramen ovale* measures an inch and a quarter in length and half an inch in breadth, but is partially divided, by slight projections of bone on each side, into a double opening. It is formed mainly by the edge of the great wing of the sphenoid, but its circumference posteriorly is completed by the petrous bone. The inner part of this foramen transmits the third branch of the trigeminus, while the outer portion is continuous with a channel

in the cranial walls which lodges one of the meningeal vessels and corresponds with the foramen spinale of human anatomy.

In the African elephant the separation is carried still farther, the ridges of bone on opposite sides approaching very near to each other.

The *Carotid foramen* is situated behind the petrous bone, but is formed equally (when seen from below) by an indentation into the petrous and basilar bones; it is at first of an oval form, its long diameter being three-fourths of an inch, but soon becomes round and diminishes to a half of an inch; as it ascends vertically, it becomes more completely imbedded in the petrous bone, and as it enters the cranial cavity as seen from within, it is wholly contained in it; at this point it becomes continuous with a groove, which runs forwards on the sides of the sella turcica and terminates just within the anterior clinoid process. From the carotid canal a small opening transmits probably a meningeal vessel.

In both the African and Asiatic elephants this foramen exists and has a similar connection with a groove on each side of the sella turcica; in the former species it is wholly imbedded at its commencement in the petrous bone. This foramen is not mentioned by Cuvier, neither in his Ossemens Fossiles nor in his Anatomie Comparée; he describes the foramen ovale and that which transmits the carotid artery as forming one opening.* As stated above, the foramen spinale and foramen ovale are united together, but the first obviously serves only to transmit meningeal vessels.

The *Internal Auditory* foramen is much depressed and forms a fissure on the upper surface of the petrous bone.

Between the petrous bone and the basilar portion of the occiput, more external than the carotid foramen, is a fissure three inches in length, which serves to transmit the hypoglossus nerve, and is therefore the representative of the anterior *Condyloid foramen;* the external part of the same fissure is more narrow and is continuous with the lateral sinuses, and is in consequence to be regarded as the jugular fossa, though the jugular vein must become very much flattened in order to escape from the cranial cavity.

The *Stylo-mastoid foramen* is one-fourth of an inch in diameter.

The *Eustachian tube* enters the extremity of the petrous bone which last is prolonged into a spine. The *Vidian canal* is of great size, perforates the pterygoid process near the base, and is of an oval form and has a diameter of about three-fourths of an inch; the posterior orifice is in close proximity to the foramen ovale and the anterior to the foramen rotundum, which it nearly

* Lecons d'Anat. Comp. Tome ii.

equals in size. The vidian canal it would seem contained something else than the vidian nerve, its size being wholly out of proportion to a filament comparatively so small. The *foramen incisivum* is much smaller than in Elephants, and is prolonged as in them into a canal which in the Mastodon measures ten inches in length.

The *foramen magnum* is nearly oval, being three inches in its transverse and two and a half in its vertical diameter.

The openings between the nasal fossæ and the diploic cells are very much larger than in the African elephant, and establish a free communication between these cells and the nasal orifices as far back as the occiput.

Leaving out of view other resemblances between the skeletons of Mastodons and Elephants, an examination of the bones of the face, especially those in the neighborhood of the nasal openings, would afford satisfactory evidence that Mastodons like the Elephants were provided with a nose elongated into a proboscis. Other evidence equally conclusive is found in a comparison of some of the foramina in the base of the skull of these two genera. In Elephants the existence of a trunk, gives rise to the necessity for a corresponding development of the motor and sensitive nerves of the face and these in turn to a proportional enlargement of the openings for their exit from the cranial cavity. The foramen rotundum and foramen lacerum transmit the sensitive nerves, branches of the trigeminus, and the stylo-mastoid foramen transmits the *portio dura* or motory nerve—and the two supply the necessary filaments to the muscles and skin. In both Mastodon and Elephant these foramina present similar proportional sizes—but in neither is the stylomastoid foramen which transmits the motory nerve or *portio dura*, as largely developed as the foramen rotundum—the latter having a diameter of a half of an inch in the Mastodon and of seven-eighths in the Elephant, while the latter does not exceed one-fourth of an inch in either. Cuvier describes the great size of the orbitar and superior maxillary branches of the trigeminus and of the portio dura in Elephants,* and more recently Mayer has more fully described and figured the same nerves, from a recent dissection of the parts.† The complete correspondence of these foramina in Mastodon and Elephant, would have enabled the comparative anatomist to determine the probable existence of a trunk in the former, even if the bones of the base of the skull only had been brought to light, the rest of the skeleton being unknown.

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* Lecons d'Anat. Comp. T. iii, pp. 199, 218. Paris, 1845.

† Beiträge zur Anatomie des Elephanten und der übrigen Pachydermen, von Dr. C. Mayer Nov. Act. Nat. Curios. T. xx, p. 1. 1847.

There is no peculiarity of the interior of the cranium of the Mastodon which more forcibly presses itself upon the notice of the comparative anatomist than its form; in this we have revealed to us the general outline and some of the details of the surface of the brain of which the cranial walls are on an accurate mould; and in this too we have additional means of making comparisons between the genera of Mastodon and Elephant and of determining another important element in their affinity.

The following measurements vary but little from those given by Dr. Warren in his memoir already cited.*

	Inches.
Greatest length of cranial cavity on median line from crista galli, to inner edge of foramen magnum,	9⅜
Greatest length from anterior part of olfactory fossa to edge of foramen magnum,	10
Greatest height on median line,	5⅛
Transverse diameter at posterior edge of orbitar fossa,	7⅛
Transverse diameter at anterior edge of occipital fossa,	5⅞
Transverse diameter through the centre of middle fossa,	10⅛

As however the cranium under consideration belonged to an immature Mastodon, but little of moment was deduced from its measurements or capacity merely. It is to the form of the whole and of its subdivisions that the principal interest attaches —and these next present themselves for description.

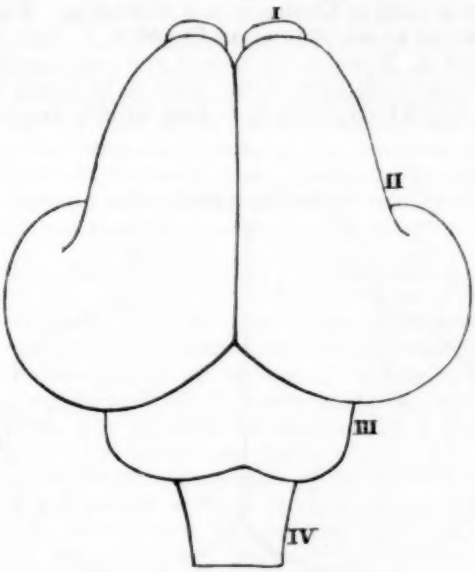
The *Olfactory lobes* are quite large in both the Mastodon and Elephant, when compared with the sensitive surface over which they preside, the index of this last being the turbinated portion of the ethmoid bone. The olfactory fossa in Mastodon is of a pyriform shape 2⅝ inches long by 1⅛ in the broadest part, and is several times longer in actual extent than the corresponding fossa in the ox or the horse; in the former the fossa measuring 1⅛ inch by ⅛th of an inch. On the other hand the sensitive surface of both these last mentioned animals is actually much longer than the corresponding ones of either the Mastodon or Elephant, as shown by the greater development of the ethmoid and lower turbinated bone. The position of the olfactory lobes is beneath the anterior lobes of the brain projecting forwards enough to be just visible when the brain is viewed from above, and as in the Elephant it resembles the situation of these parts in man. In the ox and other Ruminants, as well as in most Pachyderms on the contrary, these lobes are placed directly in front.

The *Cerebral hemispheres*, as an inspection of the accompanying figures, 1 and 2, will at once indicate, are the parts of all others which present the most characteristic feature of the encephalon. The anterior lobes are contracted to a most extraordinary degree, each having the form of a conical mass with the

* Page 119.

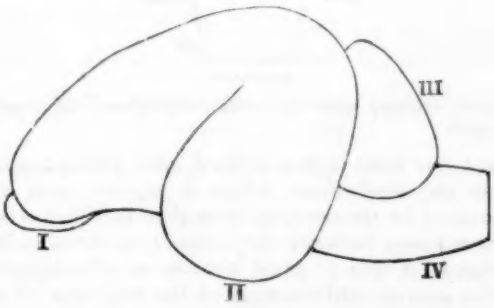
apex directed forwards and in a great measure overlapping the olfactory lobes. This conical portion terminates at the posterior edge of the wing of the sphenoid, which forms the boundary between the orbitar and middle cranial fossæ. Behind this division the brain becomes suddenly increased in breadth from $7\frac{1}{8}$ inches, which it is at the division, to $10\frac{1}{8}$, which is its diameter through its broadest part.

1.



MASTODON.

2.

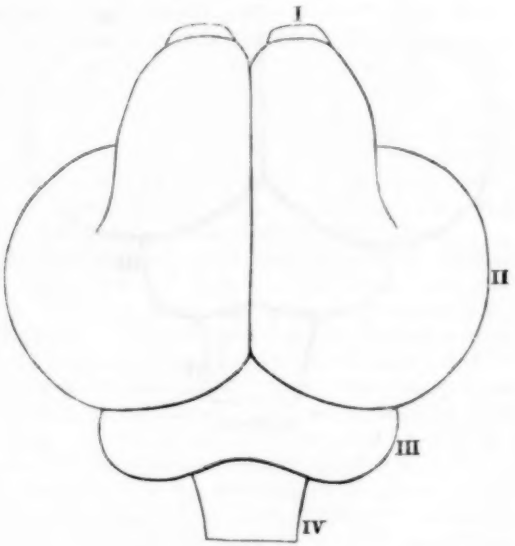


MASTODON.

Explanation.—I. Olfactory lobes.—II. Cerebral Hemispheres.—III. Cerebellum.—IV. Medulla oblongata.—The same numbers refer to the same parts in all the figures.

In Mastodon then as in Elephant the transvere diameter of the brain exceeds the longitudinal, though to a less extent in the former than in the latter; this condition of things exists only in a few instances in the Mammiferous group, and is found principally if not wholly in Cetaceans and Proboscidean Pachyderms.* In Cetaceans the transverse diameter is in still greater excess over the longitudinal, but the cerebral lobes together form a regularly oval mass; in which circumstance it makes a striking contrast with the same parts in Elephants and Mastodons. Fig. 3 represents the outline of the brain of an Elephant, E. indicus, figured and described by Mayer in the memoir previously quoted, and in which the remarkable form of the brain is especially noticed, a peculiarity which Camper seems to have entirely overlooked.

3.



ELEPHANT.

Explanation.—I. Olfactory lobes.—II. Cerebral Hemispheres.—III. Cerebellum.—IV. Medulla oblongata.

The *cerebellar* fossa is well defined, and shows a considerable elevation of the cerebellum, which it appears must have been more uncovered by the cerebral lobes than in Elephants.

The resemblance between the forms of the brain in Mastodons and Elephants, is also of great interest in a zoological point of view. The general conformation of the skeletons of these two

* See Cuvier Oss. Foss. T. i, p. 481. 3d edition.

genera is so similar, that they have always been approximated in zoological systems, their generic distinctions resting mainly on the difference in the structure and form of the teeth. But after the discovery in Burmah of Mastodon elephantoides, this distinction in some measure lost its value, and more recently the wonderful discoveries of Falconer and Cautley in the Sivalik hills of India, seem to have established an almost imperceptible gradation from E. nomadicus and Africanus, through E. planifrons, E. insignis, and E. canesa, in which last the transverse ridges are destitute of cement, to the different species of Mastodon.*

The determination of the similarity of form in the brains of these two genera, gives us another important character in which they approximate each other, and may suggest the probability that future discoveries may result in the breaking down of all absolute distinction between them; though as yet however the generic boundary is sufficiently well defined in the external forms of the heads and some of the details of the skeleton.

Note.—The figures of the brain of Mastodon given above, were obtained by projection from measurements of the interior of the cranial cavity. As the subdivisions of this cavity are separated by well defined boundaries, and as the bones in mammals are accurately moulded to the surface of the encephalon excepting in the neighborhood of the medulla oblongata, the interior of the cranium may be admitted with scarce a probability of error, as an index of the general figure of the brain. There is nothing to indicate the precise size of the medulla oblongata; the figure of this portion is therefore ideal. Some indications of cerebral and cerebellar convolutions were visible in the interior of the cranial walls, but too ill defined to warrant any attempt at laying them down in the figures. The figures of the Mastodon brain are drawn on the scale of one-fourth of an inch to an inch; the figure of the Elephant's brain is reduced from one by Mayer in the memoir before referred to.

Art. VII.—*On the Auroral Bow of June 11th*, 1852; by Rev. Chester S. Lyman.

Observations made upon Auroral Bows by independent observers so situated geographically as to afford reliable data for determining the height of the phenomenon above the earth, are somewhat rare. And as there exist different opinions among philosophers respecting its usual height, it seems desirable that any observations that may throw light on the question should be given to the public in full.

* Fauna Antiqua Sivalensis, being the fossil zoology of the Sivalik Hills in the North of India, by Hugh Falconer, M.D., &c., and by T. Cautley, F.R.S., &c.

The position in the heavens of the bow of June 11th, 1852, was noted quite definitely by Mr. E. C. Herrick at New Haven, and by Mr. Sereno Watson at East Windsor, Conn. It was also observed independently by Prof. Olmsted at New Haven, Mr. Hyde at East Windsor, and Prof. Brocklesby at Hartford; and was also seen at Meriden, Springfield, and numerous other places, but not carefully observed.

From the fact that only a single bow was noticed at any place, while the rest of the sky was comparatively free from auroral light, it is safe to presume that the several observers saw the same identical bow. This presumption is strengthened by the fact that it was seen by all the observers at about the same time, and by some of them with certain similar characteristic features, particularly its manner of disappearance. On the supposition of identity also, the observations at New Haven, Hartford, and East Windsor give an unequivocal parallax, and a parallax that gives an altitude corresponding with the determinations of Dalton, Professors Olmsted and Twining, Prof. Challis and many others, who have made similar computations respecting different bows. These observations have usually given an altitude ranging from 100 up to 200 or 300 miles. Mr. Herrick from his own observations at New Haven, and those of Mr. Watson at E. Windsor, computed the height of the bow of June 11th to be not less than 150 miles, as stated in this Journal, vol. xiv, p. 131.

That others may judge of the soundness of this conclusion, as well as of some other inferences which the facts in this case seem to justify, the original observations are here given in full as put in writing by those who made them. Those by Mr. Herrick at New Haven are as follows.

"*Friday, June 11th*, 1852.—Evening: sky clear and pure.

As early as 9 o'clock, there was a strong general Auroral light in the north, through an amplitude of 120°+, with indistinct streaming 20° or 30° high.

Looking out again about $9^h\ 50^m$ N. H. m. s. time, I saw stretching from the easterly to the westerly part of the heavens, and passing the meridian a little south of the zenith, a continuous luminous streak or bow, about two degrees in breadth, (as I judged,) and having a bend southwardly near the meridian. There was at this time only a bright general light along the N. horizon, without streamers. The sky was exceedingly clear, and there was no other auroral indication which could be confounded with this bow. There was but one bow visible, and this one was distinct, and moderately bright. The margins were tolerably well defined, and so far as I remember, either margin could in most parts be determined within one-third or one-fourth of a degree. The bow showed no fringe, nor any fibrousness of texture, and when disappearing exhibited none of the usual internal oblique beams, or segments of streamers. It appeared to be simply luminous vapor. I did not at the time note down the exact position of the west-

erly end, but if I remember correctly it was near *gamma Leonis*; and at an earlier period it probably reached a lower point. The easterly part below the altitude of about 35° was hidden from my view by trees and buildings.

At $9^h\ 52^m$, the bow is central on the star *alpha Coronæ Borealis*.
" " 53 40^s, the southern edge touches *epsilon Bootis*, (*Mirac.*)
" " 54 20, the bow is fading, and is now central at a point midway between *Arcturus* and *Mirac*: its breadth here is about one-fifth of that distance.
" " 57 0, the bow has now disappeared, except a segment about 30° long in the northwest. This extends from a point about one-third of the distance from *zeta* to *gamma Leonis* in a gentle curve, convex towards the north, expanding to a breadth of 3 or 4 degrees at the upper part, and terminating at a point midway between *beta Leonis* and *Cor Caroli*. This segment remained visible about a minute without much change of position.
" " 59 0, no trace of the bow can be seen.

The meridional part of the bow, while I saw it, had a motion southward, but at what rate could not be well determined from so brief an observation. Moreover, the changing character of the sinuosity near the meridional part of the bow embarrassed the observation on the motion towards the south."

Mr. Watson's observations are thus detailed in a letter to Mr. Herrick, dated East Windsor Hill, June 15, 1852.

"My attention was first drawn to the aurora at about 8h. 50m., when a line of streamers, reaching nearly to the zenith, formed with their bright bases of yellowish light an irregular and imperfect arch in the N. and N. W., which contrasted well with the purple shades of evening that lingered below and with the dark sky above. This arch became more regular and perfect, at length extending from 65° E. to 25° W. of N., having a height of 20° or more, but finally sunk into a bank of auroral light, fading from the horizon to an altitude of 30°, the streamers becoming less and less frequent. At 9h. 4m. a bright streamer covers β and γ of the Bear, and at 9m. waves of light are distinctly seen in the north.

The arch commenced at 9h. 23m. with a bright ray to the S. of E. just above the horizon, which in 2m. extended itself entirely across the sky, of nearly uniform breadth except in the E., where it narrowed to a point, not bright nor very sharply defined, but more so upon the N. than the S. edge and brightest overhead. Its direction was this; beginning some 10° S. of E. it passed S. of the Eagle and the Crown, covered the head of Serpens, had Arcturus on its south border and embraced α, δ, η and θ Leonis. Its width was determined by the five stars in the head of Serpens, the north star being on the north border and the arch having $\frac{1}{10}$th of its width below the southernmost. This, if I remember aright, was very nearly the position of the arch of April 7th, 1847. This also like that one was continually but slowly changing

its place, not as a whole, but first the portion west and then that east of the zenith, and in such a manner as to form curves at certain points, while the lower portions remained nearly stationary. At 9h. 34m., Arcturus is in its centre, and at 36m. the east portion has also moved south its half. At 42m., Arcturus is upon its north edge and the whole has apparently moved south its width, forming again a regular arch. At 43m. the arch is yet entire but fainter and fades gradually away, from the eastward. At 46½m. a vestige yet remains in the west 1½° or 2° wide, its north edge well defined upon β Leonis. It moves north its width and is wholly gone at 9h. 51m. The arch in the north horizon continued with few or no streamers till after 11 P. M. My watch had probably an error of some minutes."

In a subsequent letter Mr. Watson remarks, "I enclose you another set of observations made entirely independent of mine, by Mr. T. C. P. Hyde, a student of the Seminary." Mr. Hyde's notes are as follows:

"Auroral streamers—visible early in the evening twilight, and continued most of the time till 10½. Direction generally from an arch low in the north toward a point 15° or 20° south of the zenith. Length varying from 6° or 8° to 30° or more. Slight coronal appearances, not far from 8 P. M. Afterwards a column or belt appeared from E.N.E. to W.S.W., through a point outh of the zenith. At 9·30 (time not exact) the northern border of the light passed through the south edge of the Northern Crown and its southern was near Arcturus. It was slowly drifting south: left the Northern Crown about 9·40, had Arcturus near its centre at 9·50 and in its northern margin by 10. About 9·50 the southward motion of the western end of the belt was accelerated, so that the belt became concave to the south. At 10·10, the west end was perhaps 3° or 4° farther south than it would have been by a motion uniform with the central and east portion. I did not observe its subsequent return to the northward. At 10·15, a faint line of light could be traced, marking the original position of the belt, separated from the larger belt which had moved south, by a dark interval of perhaps 4° or 6° in width."

Professor Brocklesby, of Trinity College, Hartford, in a letter to Professor Olmsted, which he has kindly permitted the writer to use, describes the bow as having its southern limit, at a quarter to ten, mean time, not more than a degree distant from Arcturus.

"I noticed," he remarks, "that the southern margin was quite near to Arcturus, and immediately obtained the time from a watch belonging to Mr. Bushnell, a divinity student. The time was a quarter to ten. For two or three minutes, at least, there was no perceptible motion in the arch southward, near Arcturus. Mr. Bushnell is confident that no portion of the arch reached as far north as the crown, that the *northern* limit was clearly *south* of it." "We are agreed that the distance of Arcturus from the belt (at the time specified above) could not have exceeded one-fourth part of the width of the belt."

Unfortunately for the purposes of comparison, the *times* indicated in the observations given above, with the exception of Mr. Herrick's, are uncertain to a considerable amount. Those for Windsor may be in error ten or fifteen minutes. Professor Brocklesby, from subsequent comparison with a church clock in the city, supposes his time to be not far from correct. In respect to Windsor, this uncertainty is much diminished by the fact, that both at that place, and at New Haven, the bow was observed till it finally vanished. Its disappearance at both places was rapid, and in circumstances somewhat similar. It will perhaps be allowable, therefore, to correct Mr. Watson's time from that at New Haven. If eleven minutes, (which is about what Mr. Watson supposed his watch may have been too slow,) be added to the former, the appearances of the bow at the two places are very readily comparable with each other. It may be remarked also, that the more definite observations at these places were made within a few minutes of the disappearance of the bow. The times noted by Mr. Hyde appear to be given in round numbers, and are consequently of less value than those of Mr. Watson.

From the observations at New Haven and East Windsor, it is easy to lay down on a celestial globe the position of the belt as seen at very nearly the same time from each of these places. This cannot be done however as definitely as is desirable, on account of the rapid southerly motion of the belt, and the varying flexures in some parts of it. The position of a part of the bow near the meridian, as observed by Mr. Herrick, changed as much as four or five degrees in less than a minute. As seen from Windsor the average motion appears to have been much slower, at least in that part of the belt near Arcturus. Nine minutes after that star was in the southern border of the belt, it is mentioned as being in the center of it, and eight minutes afterwards, in the northern border.

On thus laying down the positions of the bow on a globe adjusted to the hour of the day, its parallax, as seen from the two places named, is very obvious. Even if we allow an uncertainty of several minutes in the times, and compare Mr. Herrick's latest, or most southerly position, with Mr. Watson's earliest, or most northerly, there is still left a parallax, though quite small. And if, on the other hand, we compare Mr. Herrick's earliest with Mr. Watson's latest position, the parallax, for the center of the belt, cannot be made to exceed fourteen or fifteen degrees at most.

Making the most probable correction for the times, and obtaining a mean position of the belt on the globe for each place, we estimate the altitude of the bow, in a plane perpendicular to its general direction across the heavens, to be 72° for its southern edge, as seen from New Haven, and 74° for its northern; at the

same time, as seen from East Windsor, the lower edge had an altitude of 61° and the upper of 67°.

The plane (perpendicular to the direction of the belt) in which these altitudes are taken, lies in a direction S. 8° or 9° W. of the true meridian, which angle is on the opposite side of the meridian from the magnetic variation. The bow, therefore, instead of crossing the magnetic meridian at right angles, made an angle with it about 15° less than a right angle.

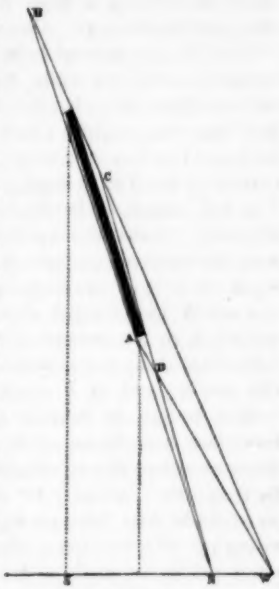
In like manner, Professor Twining, (Am. Jour., vol. xxxii, pp. 223, 227,) found the meridian of the Auroral bows of May and August, 1836, to lie on the opposite side of the true meridian instead of on the same side with the magnetic variation.

East Windsor bears from New Haven, according to the best maps, about N. 23° 30′ E., distant forty English miles. The distance reckoned in the direction of the plane in which the altitudes are estimated, is thirty-eight and a half miles.

Before making further use of these data, it may be well to direct attention more particularly to the apparent *width* of the belt. This, at New Haven, is clearly defined by Mr. Herrick to be not far from 2°. He could hardly be much mistaken in estimating one-fifth of the distance between Arcturus and Mirac. This distance is 10° 17′. As seen from East Windsor, the width could not have been less than 6 or 7 degrees. On this point Mr. Watson remarks in a subsequent letter. "For some minutes the belt was nearly stationary over the head of Serpens, and its width for some distance from the meridian very nearly uniform. I then, before any marked motion occurred, noted its breadth pretty accurately by the stars mentioned, the five stars plainly discernible in the head of Serpens, the two westernmost in a line with, and a little east of south of α Coronæ. The northern star was then nearly upon, or a little within, the northern edge of the belt, and the greatest north and south distance of the stars was nine-tenths of the width of the belt. The width was rather greater than less than that I have indicated." The distance between β and ϱ Serpentis, the northernmost and southernmost of the stars referred to, is 5° 42′. This would make the width of the belt not less than 6°. Mr. Hyde's observations confirm this estimate. Prof. Brocklesby's indicate a similar width as seen from Hartford.

If now, with a base of 38½ miles, and the altitudes given above for New Haven and East Windsor, (viz.: 72° and 74° for the lower and upper edges respectively, as seen at the former place, and 61° and 67° for the same at the latter place,) we draw a diagram like the one on the opposite page, it is manifest that a section of the auroral belt must lie *within* the elongated trapezium A, B, C, D. And as each of the four sides of the trapezium is tangent to the belt, its position must be somewhat that of

the broad line in the figure. Hence, if both observers saw the same belt, and the apparent width was, at each place, that stated above, the belt could not possibly have been either of a cylindrical form, or a flat band lying horizontally. The only possible form to meet the observed conditions, must be that of a curtain or thin sheet of auroral light, seen more or less edgewise by the different observers, and making an angle with the perpendicular as represented in the diagram. This angle, in the case before us, must, as is obvious from the figure, be nearly equal to the zenith distance of the bow as seen from New Haven, or between 16° and 18°. Now this so nearly coincides with the inclination of the dipping needle, (73° with the horizon at New Haven,) that it may fairly be presumed the belt is under the same magnetic conditions as the ordinary streamers, which are known to coincide in direction with the lines of magnetic force, as indicated by a freely suspended needle. On this presumption, the section of the bow, represented by the heavy line in the figure, is drawn with an inclination of 73° to the horizon. Of course, at New Haven it must have been seen edgewise, and the visual lines touching what appeared to be its northern and southern edges, touched, more properly speaking, its northern and southern *faces*, and thus limited not its *width* but its *thickness*. Supposing this to be the true form and position of the belt, and that the cotemporaneous altitudes given above are correct, the real vertical width of this sheet or curtain of auroral light must have been not far from 150 miles, the perpendicular distance of its lower edge above the earth being about 140 miles, and that of its upper edge about 280 miles.



N, New Haven.
W, East Windsor.
Angle SNA, 7°.
" SNC, 74°.
" SWA, 61°.
" SWB, 67°.
Base NW, 33·5 miles.
Scale, 120 miles to an inch.

The conclusion of Dalton respecting auroral beams, (Meteorology, 1834, p. 165, Prop. 5,) is interesting in this connection, viz.: that, "The distance of the *beams* of the aurora from the earth's surface, is equal to the length of the beams, nearly." He appears to have considered the rainbow-like arches or belts, as a distinct phenomenon from the ordinary beams; though in some manner connected with them. He says, it is very probable they are

either at the top or bottom of the beams, and is inclined to think they are at the top. But if the view of the subject taken above is correct, the auroral bow may be regarded as nothing more than a curtain or sheet made up of contiguous beams, and seen more or less edgewise. Such curtains, seen at such an angle as to render their curtain-like character manifest, are occasionally noticed, during an aurora, and some striking examples have been figured by travellers as seen in high northern latitudes, particularly at Bossekop in Finland, 1838–40, by MM. Lottin, Bravais, &c., of the Scandinavian Scientific Expedition. If we imagine such a curtain, crossing the meridian nearly at right angles, and having an inclination equal to that of the dipping needle, to be moving slowly towards the south, at a height above the earth nearly equal to its vertical width, it might present successively, to a particular observer, the following different aspects. When first seen comparatively low in the north, and at a great distance, with other similar sheets of beams before or behind it in the same direction, it would help form the low dense arch of auroral light so often visible a few degrees above the northern horizon. Such a curtain, on moving further south, would, by the effect of perspective, appear to rise in altitude, and become separated from the mass of beams beyond, covering the northern sky with streamers more or less near to each other, or with a diffused auroral light. As it approached the zenith of the observer, the length of the beams would seem to shorten from being seen in perspective, while the light would become more condensed, and the whole assume the form of a broad arch, or diffuse belt, more or less irregular and feathery, spanning the heavens. On passing to the south of the zenith, its apparent width would diminish, and the intensity of its light increase, until it reached the direction of the dipping needle, when being seen edgewise, its apparent breadth would be reduced to a minimum, and its margin become better defined. If it passed still further south, it would again increase in width, and diminish in brightness, until it finally vanished, or resolved itself into ordinary streamers. This change in the apparent width of the belt as it passed southwardly from the zenith, has been often noticed. It is mentioned particularly by the observer at Edinburgh, of the aurora of March, 1826, discussed by Dalton in the Phil. Trans. for 1828.

Whether this be the true theory of the form and position of the belt or not, the fact that the observations before us seem to require such a theory, should direct the attention of observers more particularly to the precise *width* of the belt, as well as to its *altitude* or position among the stars.

The numbers given above for the height of the bow of June 11th above the earth can be regarded only as an approximation, owing to the difficulty before mentioned of deciding upon the

precise parallax. Taking the largest parallax possible in the case without regard to coincidence of time, no part of the arch could have been less than 100 miles above the earth. While if we use the smallest parallax that might be thus made out, we should place the phenomenon at a height of three or four hundred miles. But such a use of the data is unwarranted. The most probable result is that which we have given. It may be remarked further, that at the height of 200 miles, the angle of 2° subtended by the belt at New Haven, would give for its actual *thickness* about seven miles.

If the segment of the arch remaining in the west after the rest of it had vanished, be laid down on the celestial globe as seen both from New Haven and East Windsor, the difference in the apparent positions will show a similar parallax to that determined from observations near the meridian. The altitude of the lowest point in the west as seen by Mr. Herrick was about 24°. If the real height of this point was 140 miles, its distance from the observer was less than 300 miles, which in the direction N. 80° W. would make it perpendicular over western New York.

ART. VIII.—*Notes on Kilauea and the recent Eruption of Mauna Loa;* by Rev. TITUS COAN.*

I HAVE but recently returned from a tour of nearly two hundred miles—embracing the shores of Puna, a visit to old Kilauea, and an ascent to the seat of the late eruption on Mauna Loa. On this expedition I was accompanied by two sons of Mr. Alexander, one of Mrs. Chamberlain's, three of Mr. Lyman's, and one of my own. Our route through Puna you will remember with all its "lions." You recollect the limpid lake, full of mullet, at Keau; the green lake in a crater at Kapolo; the hot pool in the cavern at Opihikao; the tepid lake at Kalepena; the fissure bath at Kahaualea; the salt-works at Kealakomo, &c. From the last named place, which is the farthest point you visited, we ascended a precipice of 1000 feet and in one day reached Kilauea. Here we spent one night, and were cheered and entertained by the brilliant fireworks of old mother Pele. I had visited this scene in March, and found the action in the crater much increased. On this occasion the action was still more intense. The great dome, one mile and a-half in circuit, and several hundred feet high, has now lost its key stone, and the massive arch is fallen in. The orifice on the summit is some two hundred feet in diameter, and down this opening you look directly upon the raging lake below. On one side the dome is rent from the base to the summit, and through this fissure, smoke and lavas

* From a Letter addressed to C. S. Lyman, dated Hilo, Hawaii, July 31, 1852.

pass off from the boiling chaldron. This fiery lake, so long concealed by the ponderous dome, is gradually rising and lifting and rending the superincumbent strata of which the great dome is composed, and threatening at no distant day to engulf the whole overhanging mass within its burning bowels.* Crag after crag, and mass after mass, are being loosened from the walls of this fiery orifice and precipitated like an avalanche into the abyss below. Thus the conflict will go on, until the old furnace of Vulcan opens to view in all its original dimensions, and burns, and glows, and rages, with the vehemence of former years. Aside from this increased action within the dome, no important changes have occurred in the crater for two years past. From Kilauea, we took a northwest course toward the seat of the late eruption. For three miles we had a good path and passed through immense fields of Ohelo, a variety of whortleberry. We then entered a thick forest, about four miles deep. From this we issued into an open field of lava, sprinkled with shrubbery, and inhabited by wild goats, wild geese and wild birds. On, on we went, climbing and still climbing, until the crater and the petrified river, for which we were toiling, came into view, and at night we encamped within five miles of the cone whose awful thunderings and glaring fires spread such consternation in February and March.

Taking an early start the next morning, at eight, A. M., we stood on the summit of this cone and surveyed it with perfect composure. It is now extinct, with the exception of some heat and steam from some of the crevices. We went round it, over it and into it. It is seventy-four chains in circumference at its base, nearly five hundred feet high, and has a crater four hundred or five hundred feet deep. It is an irregular, hollow, truncate cone. I found its summit to be a little higher above the sea than Haleakala on Maui, which is 10,000 feet, and which was in full view. Mauna Kea was also standing uncovered in bold relief, towering in sublime grandeur to the heavens.

From this summit, we could also survey the cooled stream down the mountain side, over the blackened scoria plains, far into the forests of Hilo. Byron's Bay, also, and the shores of Hilo, lay like a map at our feet.

At several points at the base of the mountain, and in the forests, the lava was still smoking, but for the most part it was extinct; and the atmosphere was so pure and so free from smoke that we enjoyed a most grand panoramic scene. Where the molten stream issued from the crater it made an opening in the rim, through which it flowed with great rapidity. From the crater several

* The reader will remember that this lake is in the crater of Kilauea, at its southernmost extremity, and covers but a small part of its whole bottom, although the dome which has covered it is 1800 to 2400 feet in diameter at base. The lake when fully open, measures 1000 feet by 1500 in diameter.

miles down the mountain the stream is half a mile wide, but at the base of the mountain it spreads to the breadth of three or four miles. In some places it formed a multitude of channels, and enclosed numerous islands of ancient lava and scathed and charred forest trees. The whole length of the stream, including its windings, may be forty or fifty miles, and it approached within about ten miles of Hilo.

I engaged men to cut through the forest from Hilo, find the terminus of the stream, trace it through the woods, meet me on the mountain, and lead me down the channel to Hilo. But the men did not commence in season, so that we had left the mountain by another route before they came up. This was a disappointment, as I had intended to measure and know definitely how near the eruption approached us, and whether its direction would, probably, have brought it to our station. These facts I have yet to determine.

Had the flow been direct, and had it been confined to a channel of half a mile in breadth, it would have reached the shore in less than two days. But its consistency was so great, its windings so numerous, and the obstacles in its track so many, that, although the great fountain played furiously for twenty days, still the stream spent itself in the inland regions. And there it now lies like a petrified serpent, stiffened in death in the forests behind us.

But to return to our point of view on the cone. What a contrast! This whole frowning pile on which we stood was but recently a glaring pyramid of fire, and from this dark throat, down which we now calmly gazed, ascended a fiery column a thousand feet in diameter and seven hundred feet high, with mutterings and roarings that might make the stoutest heart "fear and quake." This atmosphere, now so pure and cloudless, was filled with whirling, careering clouds of sulphurous smoke—murky, red, blue, green, black—darkening the heavens, hanging like awful portents of wrath above, or sweeping away in convolving and angry masses to the distant horizon. Here I now calmly viewed the spot, on which in February last, I sat surveying this terrific pile of fire, and feeling its hot flashes on my very cheek; and the place where I then kept vigils through the live-long night, and saw, and heard, and felt things unutterable. Now, all was calm as death—all still as the grave—all wild and desolate as chaos.

I found sulphur and gypsum in small quantities, but I noticed no other salts. There is nothing new or striking in the products of this eruption. The common lavas of Hawaii abound here. A kind of pumice is very abundant, and widely scattered. We found it ten miles from the crater and it grew more and more abundant till we reached the cone where it covers the whole region to the depth of five or ten feet.

Art. IX.—*Temperature of the air and surface water of the Sea, taken on a voyage from Samoa to Valparaiso, in* 1841; by W. C. Cunningham.*

1. From the harbor of Apia, Island of Upolu, to Tahiti.

Date.	Latitude.	Longitude.	Winds.	Sea.†	Air.†	Weather.
May 11	15° 2′ S.	172° W.	N.E.	78·30	77	fine.
12	15 ·02	172 ·37′	S.S.E.	78 ½	78	showery.
13	16 ·04	"	E. by S.	78·10	78	do., heavy rains.
14	17 ·27	174 ·43	S.E.	78·	78	dark.
15	17 ·58	174 ·16	E.	78·	77	fine but cloudy.
16	18 ·50	173 ·41	S.E.	78·	76	do. do.
17	19 ·47	173 ·28	S.E.	78·	76	clear.
18	19 ·37	172 ·41	S.	77·½	71	clear and fine.
19	19 ·57	170 ·47	S.	76·	75	cloudy.
20	20 ·21	169 ·11	S by E.	76·½	74	cloudy.
21	20 ·16	167 ·21	S. by E.	76·½	72	cloudy.
22	20 ·18	167 ·03	Var.	76·	74	clear.
23	21 ·09	166 ·37	S.	74·½	76	dark.
24	2 ·46	164 ·29	S.	75·	75	cloudy.
25	26 ·30	163 ·33	S.	76·	74½	fine.
26	19 ·52	163 ·01	S.	77·	75	dark.
27	19 ·23	161 ·53	S.E.	73·	75	do.
28	20 ·07	162 ·22	S.E.	73·	76	fine.
29	21 ·04	162 ·54	S.S.E.	72·	76	cloudy.
30	21 ·16	162 ·46	E.S.E.	71·	76	cloudy.
31	23 ·00	162 ·45	N.N.E.	72·	76	clear.
June 1	22 ·06	160 ·48	Var.	74·	76	fine.
2	22 ·46	161 ·19	S.S.W.	74·	74	clear.
3	21 ·00	160 ·00	E.	74·	75	fine; at *Rarotonga*
11	22 ·21	160 ·20	E.	73·	72	fine.
12	22 ·24	160 ·25	E.	73·	72	do.
13	22 ·49	159 ·33	Var.	73·	72	do.
14	22 ·29	158 ·54	E. by S.	72·	72	do.
15	22 ·25	159 ·37	N.N.E.	71·	71½	do.
16	22 ·37	159 ·05	Var.	71·	71	at *Mangaia*.
17	..	..	Var.	70·	71	fine.
18	..	..	S.S.E.	68·	72	do.
19	21 ·39	156 ·42	S.E.	68·	72	dark.
20	21 ·06	155 ·47	S.S.E.	68·	73	do.
21	20 ·53	154 ·20	S.S.E.	68·	74	fine.
22	20 ·36	152 ·34	S.S.E.	68·	76	do.
23	20 ·21	151 ·18	S.E.	70·	76	do.
24	19 ·10	151 ·11	S.E.	71·	76	do.
25	..	..	E.	..	..	*Tahiti*.

* The above table of meteorological observations were received by the writer long since, with a letter dated Talcuhuano, Chili. Mr. Cunningham, in 1840, was English Vice Consul at the Samoan or Navigator Islands in the Pacific, where the writer had the pleasure of making his acquaintance. The table has peculiar interest, since the route travelled is one seldom passed over by vessels.—J. D. D.

† Mean temperature.

2. FROM TAHITI TO VALPARAISO.

Date.	Latitude.	Longitude.	Winds.	Sea.*	Air.*	Remarks.
Aug. 26	18°·77′	151°·01′	S.E	73	76	fine.
27	20 ·10	151 ·33	S.E.	72	75	clear.
28	22 ·02	152 ·06	S.E.	72	75	do.
29	22 ·18	152 ·45	S.E.	75	73	do.
30	22 ·30	151 ·38	Var.	76	72	do.
31	23 ·15	152 ·47	S.E.	68	72	do.
Sept. 1	24 ·24	152 ·51	S S.E	68	72	do.
2	25 ·14	152 ·12	N.N.E.	69	72	cloudy.
3	26 ·13	151 ·41	S.W.	69	70	clear.
4	27 ·18	150 ·47	S.W.	65	66	fine.
5	28 ·46	149 ·49	S.W.	63	68	clear.
6	28 ·40	149 ·49	S.W.	62	66	do.
7	29 ·21	150 ·21	W.	61	65	rains.
8	30 ·19	151 ·40	S.E.	60	65	cloudy.
9	31 ·30	152 ·43	S E.	58	60	squally; dark.
10	32 ·30	152 ·46	S.E.	58	60	do. do.
11	33 ·45	151 ·56	Var.	58	57½	cloudy.
12	34 ·42	150 ·27	Var.	56	58	thick and cloudy.
13	35 ·43	148 ·53	N.E.	56	56	cloudy.
14	36 ·50	147 ·15	N.E.	56	56	clear.
15	38 ·19	146 ·37	Var.	55½	55	cloudy.
16	39 ·23	145 ·38	N.E.E.	53	52	do.
17	40 ·18	143 ·43	N.E.	50	51	rain; dark.
18	40 ·01	141 19	N.E.	52	52	do. squally.
19	39 ·05	139 ·11	N.N.E.	55	54	clear.
20	38 ·24	136 ·58	N. by W.	56	55	foggy.
21	38 ·09	134 ·08	N.N.W.	56	54	do.
22	37 ·42	130 ·38	N.N.E.	56	55	cloudy.
23	37 ·23	127 ·22	N.N.W.	55	54	rains.
24	36 ·52	124 ·06	N.N.W.	56	54	do.
25	37 ·05	121 ·00	N.W.	58	57	clear.
26	37 ·05	117 ·32	W.	56	55	do.
27	37 ·11	114 ·18	N.W.	56	54	squally.
28	37 ·03	112 ·19	Var.	58	57	do.
29	36 ·47	108 ·58	N.W.	57	55	cloudy.
30	36 ·48	106 ·31	W.	57	55	do. mild.
Oct. 1	36 ·29	104 ·12	Var.	58	57	squally.
2	36 ·22	103 ·30	Var.	55	56	do.
3	36 ·42	101 ·00	N.N.W.	58	56	cloudy.
4	37 ·12	97 ·06	N.W.	58	57	do.
5	36 ·58	94 ·30	W N.W.	58	56	do.
6	37 ·11	90 ·20	W.N W.	56	54	clear.
7	36 ·18	88 ·11	W.N.W.	57	55	do.
8	35 ·28	84 ·55	N.W.	56	56	do.
9	34 ·14	82 ·08	N W.	54	56	do.
10	34 ·06	74 ·25	Var.	57	57	do.
11	34 ·03	73 ·06	S.W.	57	56	fine.
12	34 ·48	72 ·10	N.N.E.	57	57	do.
13	33 ·39	72 ·40	N.	56	57	do.
14	33 ·33	72 ·50	N.W.	56	57	do.
15	33 ·10	72 ·04	S.	56	56	do.
16				55	54	do. at *Valparaiso.*

* Mean temperature.

ART. X.—*Notice of a Binocular Microscope;* by J. L. RIDDELL.

I DEVISED last year, and have lately constructed and used, a combination of glass prisms, to render both eyes simultaneously serviceable in microscopic observation.

Behind the objective, and as near thereto as practicable, the light is equally divided, and bent at right angles, and made to travel in opposite directions, by means of two rectangular prisms, which are in contact by their edges somewhat ground away. The reflected rays are received at a proper distance for binocular vision, upon two other rectangular prisms, and again bent at right angles; being thus either completely inverted, for an inverted microscope; or restored to their first direction, for the direct microscope. These outer prisms may be cemented to the inner, by Canada balsam; or left free, to admit of adjustment to suit different observers. Prisms of other form, with due arrangement, may be substituted.

I find the method is applicable with equal advantage, to every grade of good lens, from Spencer's best sixteenth, to a common three inch magnifier; with or without oculars or erecting eye-pieces; and with a great enhancement of penetrating and defining power. It gives the observer perfectly correct views, in length, breadth and *depth*, whatever power he may employ. Objects are seen holding their true relative positions, and wearing their real shapes. A curious exception must be made. In viewing opake solid bodies, with one eye-piece to each eye, depression appears as elevation, and elevation as depression, forming a singular illusion. For instance, a metal spherule appears as a glass ball silvered on the under side; and a crystal of galena, like an empty box. By the additional use of erecting eye-pieces, the images all become normal and natural. Match drawings of any solid object, made from each eye-piece, by the aid of the camera lucida, when properly placed in the common stereoscope, appear to stand out in natural relief. These, if engraved and printed in the proper position with respect to each other, might find an appropriate place in books on the arts and sciences.

In constructing binocular eye-glasses, I use, for lightness and economy, four pieces of common looking-glass, instead of prisms.

With these instruments, the microscopic dissecting knife can be exactly guided. The watch-maker and artist can work under the binocular eye-glass, with certainty and satisfaction. In looking at microscopic animal tissues, the single eye may perhaps behold a confused amorphous or nebulous mass, which the pair of eyes instantly shapes into delicate superimposed membranes, with intervening spaces, the thickness of which can be correctly estimated. Blood corpuscles, usually seen as flat disks, loom out as oblate spheroids. In brief, the whole microscopic world, as thus displayed, acquires a tenfold greater interest, in every phase exhibiting, in a new light, beauty and symmetry indescribable.

University of La., New Orleans, Oct. 1, 1852.

ART. XI.—*On a new Method of Illuminating Opake Objects, for the high powers of the Microscope:—and on a new Achromatic Condenser;* by J. L. RIDDELL.

THE front or terminal combination of the objective, is made to condense light upon the opake object, by sending rays of light from behind, through the marginal border of the lens.

To accomplish this, a circular disk of fine plate glass, say near a fourth or fifth part as thick as the diameter of the lens, is bevelled on its outer margin, by grinding and polishing to an angle of 45°. A hole is drilled through the center of the disk, of a diameter, say two-thirds, three-fourths or four-fifths (dependent upon the angle of aperture,) as great as that of the lens. The margin of this hole is also bevelled at an angle of 45°, down to a clean sharp edge. Both rings of bevels are on the same side of the glass, so that if considered as projected, the lines would cross each other at right angles.

I find no insurmountable difficulty, in giving an exquisite form and finish to these disks. I mount and revolve the disk on a good rose lathe; at the same time the grinding or polishing tool is revolved by an overhead motion, the spindle carrying the tool being mounted upon a slide rest, and admitting of a protrusive movement at an angle of 45° to the axis of the lathe.

The disk being finished, is to be placed centrally behind the lens, the bevelled margins looking backward, and the sharp inner edge almost or quite touching the lens. Parallel rays of light being thrown upon the disk, in the direction of the axis of the objective, from below in the direct, from above in the inverted microscope, a ring of parallel rays is sent, by two successive internal reflections from the bevelled surfaces, so that, with direction reversed, the light traverses the outer margin of the objective, and by it is condensed upon the object in focus.

I tested this method of illumination in March last, sufficiently to be satisfied of its great value; more especially where the objective is of very short focal distance, and where consequently, other means of illuminating opake objects, cannot, on account of the nearness of the objective to the object, be resorted to.

New kind of Achromatic Condenser suggested.

A larger, thicker, similarly bevelled disk, with the bevels on opposite sides of the plate glass, and their lines of inclination coincident, would probably serve as an efficient achromatic condenser of parallel rays. By attaching centrally, on the side opposite the bevel, achromatic lenses of proper size, or a good doublet combination, a most valuable form of achromatic condenser, would I think be produced, useful for general microscopic illumination. I have not yet put the plan in practice.

University of La., New Orleans, Oct. 4, 1852.

ART. XII.—*On the Paramecium aurelia;* by OGDEN ROOD, A.B.

[Read before the Berzelian Society of Yale College, Nov. 30.]

HAVING accidentally produced a large crop of the Paramecium aurelia in an infusion of hay, I was tempted from their very abundance to make some observations. One of the most remarkable features of this animalcule is the possession of two or more star-like contractile vesicles. Ehrenberg, according to Pritchard, "considers the rays of the star-like vesicle as a ductus spermatici, which is long and enters the ovarium at many points."

It will be seen by an attentive examination that the said duct discharges *into*, and not from, the vesicle a quantity of liquid which distends and fills it in about a minute, when the vesicle contracts ejecting the liquid from the body by a small opening: then the ducts empty into the vesicle their immediate contents and afterwards recommence the filling operations as before. Now it is evident that the liquid thus thrown off by the creature cannot be an animal secretion, for the amount is too enormously large: moreover it differs not in its refracting power from water; the most natural conclusion then is that it is water. On placing a number of these animalcules in water mixed with indigo and compressing the drop so that they shall be held *nearly* stationary, but by no means crushed, the action is apparent; the indigo with the water is seen to enter by the mouth near the middle of the body, and at the bottom of the mouth the pigment is rolled around till it forms a ball: meanwhile the ducts are seen to distend conveying the water from the mouth into the respective cavities. If this view of the matter be correct, the P. aurelia is not, as was formerly supposed, possessed of male organs. I have not been able, except in two or three doubtful cases, to trace the ducts *completely* to the mouth. The vesicles with the ducts are situated near the surface and immediately under the investing membrane, being thus out of the way of foreign bodies introduced into the interior of the animalcule. It is to be remarked that the cavity into which the ducts empty is not one fortuitously formed in the mobile substance of the body, but is lined with a distinct membrane. This can be observed by cautiously crushing an individual so as merely to rupture the integument, when the contents pour out: the vesicle with the water contained in it will then pass out without breaking up and mixing with the surrounding particles. The action of the cilia surrounding the body would seem to be involuntary, for when the body is much

1.

200 Diam.

broken and the contents pouring out, they continue their motion with unabated vigor, differing in this respect from those of the mouth.

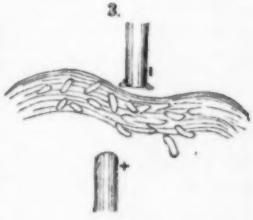
When a number of these animalcules are dried on a plate of thin glass and afterwards heated to redness, an inorganic residue remains corresponding to each individual. This residue although not differing materially in shape from the original, yet has been so much shrunk that it is not more than one-fourth of its size. On treating it with hydrochloric acid it is not attacked, whence it is supposed to consist of silica. It would seem that the deposit takes place in the investing integument, as this though flexible is possessed of considerable toughness.

2.

200 Diam.

On passing a feeble galvanic current through water containing these animalcules, on the circuit being completed, a streak of organic matter begins to form between the poles, but nearer the negative; animalcules in the neighborhood and those touching it cease to swim forward, revolve for some time on their longer axis and then move no more. Examined with a high power, neither mouth nor body cilia are seen to be in action; the body may be observed to be gradually dissipating, and the fine contents arranging themselves along the band. Many burst outright, particularly those which approach near the poles, discharging their entire contents; these also become arranged along the band. A few wheel animalcules which happened to be in the water were by no means equally affected. I neglected to measure the bubble of hydrogen produced, but in no case could it have been larger than $\frac{1}{100}$th of an inch, even after the lapse of several minutes.

3.



15 Diam.

On the application of different reagents these effects followed: alcohol soon caused the action of the mouth to cease which was shortly followed by the cessation of the action of the body cilia —death of course ensuing; often the soft contents contracted leaving a portion of the integument unoccupied. Phosphate of soda caused death in a few minutes; sulphate of magnesia, chlorid of ammonium, acetate of lead, and perchlorid of mercury caused death immediately. Cyanid of potassium the same, attended by instant rupture of membrane and violent discharge of contents. When a quantity of oxalate of ammonia is added to the water in which they are swimming, its immediate effect is to stupefy; the action of the mouth and of the cilia cease and to all appearance the animalcules are dead. But in the course of a few minutes they revive and swim about with undiminished vigor; death does not follow, at least not under several hours.

Neither ferricyanid of potassium nor neutral chromate of potash cause death, at least not under several hours. This last fact suggests the possibility of chemically injecting, even while living, these and other species of infusoria, by the mixture of proper reagents causing colored precipitates. The precipitation would probably take place not only in the surrounding fluid but also in the body of the animalcule, thus demonstrating its structure.

ART. XIII.—*On the Causes which may have produced Changes in the Earth's Superficial Temperature;* by W. HOPKINS, Esq., M.A., F.R.S., Pres. G.S., and Pres. Cambridge Phil. Soc.*

HAVING discussed the operation of internal and external causes on the temperature of the surface of the earth, I now proceed to the consideration of the influences of superficial causes depending on the configuration of land and sea, and on the oceanic currents which result from such configuration, or are greatly modified by it. The admirable map of isothermal lines by Humboldt and Dove, embodying, as it does, all the best-established observations on temperature in all the accessible regions of the earth, affords us data for this investigation far superior to all we have hitherto possessed. Every geologist is aware how long and ably Sir Charles Lyell has advocated the efficiency of the above-mentioned causes of change of climatal conditions; but before the publication of this isothermal map, the geologist had no adequate means of estimating numerically the effects which these causes were capable of producing. The want of this quantitative evaluation of the intensity of assigned causes has hitherto necessarily given to the theoretical views founded upon them much of a conjectural character, which it is my object with the improved means we possess, as far as possible to remove.

Every separate configuration of land and sea which we may suppose to have existed at any assigned geological period would require a separate investigation, in order to ascertain its effect on the climatal conditions of that period. In this paper I shall restrict myself to the examination of those hypothetical cases which, according to the general views of different geologists, may have been actual cases during the later periods of geological history; and my more especial object will be, moreover, to ascertain whether any of these supposed configurations will enable us to account for the cold of the glacial period in our own region of western Europe; and, if so, which of them must be regarded as most effective for this purpose.

* From the Quarterly Jour. Geol. Soc., viii, p. 56.—In citing this memoir, we omit Part I, which treats of the Influence of the Earth's Internal Heat and of the Heat radiating from external bodies on the Earth's superficial temperature. The course of argument is mentioned in this Journal, [2], vol. xiv, p. 282.—EDS.

9. In examining the course of the isothermal lines for the northern hemisphere, we are at once struck by their extraordinary deviations from parallelism with the equator, which must be considered as their normal type. The most remarkable of these deviations is that which exists in the northern part of the Atlantic and in the adjoining parts of the North Sea. The isothermals for every month, but especially those for the winter months, have an extraordinary deviation and convexity towards the north. Again, in northeastern Asia the abnormal courses of these lines are almost equally remarkable. For the winter months, the deviation, and consequent convexity, of the lines is here to the south; while the summer lines deviate, on the contrary to the north. Deviations also exactly similar to those of northeastern Asia exist in the northern part of the New Continent. The deviations from the normal types in the southern hemisphere are much smaller, the principal ones being those on the western coast of South Africa, and the western coast of South America respectively.

The abnormal forms of the isothermals in the northern Atlantic and North Sea are manifestly due principally to the warm waters of the Gulf Stream; those of eastern Asia and North America are attributable to the existence of large masses of land in high northern latitudes; while those above-mentioned in the southern hemisphere are immediately traceable to the influence of the well-known ocean-currents setting from the south towards the equator along the coasts of southern Africa and South America. The water of these currents reduces the temperature of those parts of the ocean through which they pass, and consequently also that of the superincumbent atmosphere, and thus causes the isothermals to deviate to the north of their normal positions. Thus an examination of all the principal deviations of the isothermal lines from their normal types leads to the conclusion that ocean-currents and the configuration of the great continents are the principal general causes which produce irregularities in the forms of those lines; and, moreover, a knowledge of these causes enables us to assign to the isothermals their approximate positions in any proposed hypothetical case in which the disposition of land and sea should be different from that which obtains at the present time.

The different hypothetical cases for which I shall endeavor to determine the isothermal lines are the following:—

(1.) The configuration of land and sea the same as at present, but without the Gulf-stream.

(2.) The Gulf-stream the same as at present, except that its progress into the North Sea is supposed to be arrested by a barrier of land, extending from the north of Scotland to Iceland and thence to the coast of Greenland.

(3.) The basin of the Atlantic from the Tropic to the North Sea converted into land, uniting the old and new continents.

(4.) Large portions of the continents of Europe and North America submerged beneath the surface of the ocean, and the Gulf-stream diverted into some other course.

The consideration of these cases will occupy the first Section of this part of the memoir.

10. The *snow-line*, or that line on the side of a mountain above which the snow never disappears at any season of the year, bears an important relation to glaciers, since it divides that higher region, in which productive agencies prevail in augmenting superficially the mass of a glacier, from the lower region, in which the destructive agencies predominate. It is essential to our investigations to know the vertical distance which existing glaciers usually descend beneath the snow-line, that we may be able to judge by analogy of the probable distances to which ancient glaciers may have descended.

As we ascend from the surface of the earth, the *mean annual temperature* decreases according to laws which have been approximately determined by observation. If this temperature, therefore, at any proposed place be greater than 32° F., we shall arrive at this latter temperature only at a certain elevation above the earth's surface. A line on the side of a mountain, or an imaginary line in space, along which the *mean annual temperature is* 32° F., I define as the *line of* 32° *F.* Its height can be approximately calculated for any place at which the mean annual temperature is known. In sufficiently low latitudes it will be at a considerable height above the earth's surface, but will descend to the surface along the *mean annual isothermal* of 32° F. as we proceed into higher latitudes. The relative heights of this line and of the snow-line at the present time depend on circumstances. It is essential to ascertain these circumstances and their influence, that we may be the better able to estimate the height of the snow-line in the hypothetical cases which I purpose to consider. We shall then be able, as intimated in the preceding paragraph, to estimate the height above the level of the sea to which the ancient glaciers may have descended. The second Section of this Part will be occupied with the consideration of these points. In the third and final Section I shall offer some observations on the relative claims of the different hypotheses of the first two Sections to form the foundation of geological theories.

§ I. *On the Positions of the Isothermal Lines in the above-mentioned hypothetical cases.*

11. Taking the first case, that of the absence of the Gulf-stream, let us trace the probable course of the January isothermal of 32° F. Proceeding from east to west, we observe that it attains its most southerly point on the high table-lands of south-

eastern Asia, proceeding thence with a little inclination towards the north until it has passed the Black Sea and arrived at the longitude of 20° E. As far as this point we may assume its position to be unaffected by the influence of the Atlantic waters warmed by the Gulf-stream. This influence, however, begins to show itself immediately to the west of the point above-mentioned, in the irregular and extensive deflection to the northward, which there begins to characterize this isothermal. This deflection is not entirely attributable to the Gulf-stream, for the Atlantic Ocean, independently of any warming currents, would undoubtedly produce some effect in lessening the winter cold of western Europe, and therefore produce northern inflections of the winter isothermals. Another reason for the more northern position of this line in western Europe than in southeastern Asia is the absence of that high table-land in the former region which characterizes the latter. To represent these influences, I have drawn the isothermal for our supposed case so as to continue to the coast the general northward direction which the actual line acquires about the 20th degree of longitude. This causes it to meet the Atlantic on the extreme western coast of Brittany. If we should draw the isothermal directly west from the meridian of 20° of long., it would cause the isothermal of about 24° F. to pass through that point of the coast through which the line of 32° F. passes as I have drawn it, so that 8° is thus allowed for the influence of the Atlantic Ocean, independently of the Gulf-stream, on the mean January temperature about these parts of the coast of western Europe. The actual temperature of the west coast of Brittany for January is about 42° F., instead of 32° F., as it would be in the absence of the Gulf-stream, according to the position of my imaginary isothermal for that case. I am, therefore, thus assigning an amount of 10° F. for the influence of the Gulf-stream on the January temperature of the coast of Brittany. The whole effect, therefore, of the Atlantic with the Gulf-stream on that coast is thus estimated at 18° F.

In traversing North America, the extensive mass of land to the north brings down the winter isothermals again to almost as low latitudes as in eastern Asia. The actual isothermal of 32° F. meets the American coast a little south of Philadelphia, and then pursues a very nearly western course until it reaches the meridian of about 106° W. long., where it begins to be affected by the Pacific Ocean and to deviate considerably to the northward. To complete my hypothetical line of 32° F., I join the point to which we have already traced it on the coast of Brittany with that at which the actual isothermal meets the coast of Philadelphia as just mentioned, the connecting line being slightly convex towards the north on the coast of Europe, and to the south on the coast of America, as is required by the continuity of its curvature. Across America, and to the west of it, the isothermal

must manifestly be beyond the influence of the Gulf-stream, and our hypothetical line must consequently coincide with it.

It would appear from the existing isothermals, that the Gulf-stream produces little effect on the temperature, even in winter, on the eastern coast of America, as compared with its effect on the western coast of Europe. There are several causes which may be assigned for this difference. After the stream has passed the straits of Bahama, it passes into an ocean of which the temperature is not much inferior to its own, and more northerly its influence must be in some degree counteracted by the cold current proceeding southward through Davis's Straits. To the influence of these causes may be added that of the west winds which appear to prevail on the eastern coast of America as well as on the western coast of Europe. These, coming from the land in the former case, and from the ocean in the latter, tend to lower the winter temperature on the American, while they raise it on the European coast.

The deflection of the actual January isothermal of 32° to the northward on the western coast of N. America is considerably more rapid than that of my hypothetical line on the western coast of Europe. It also exceeds that of the lines of 41° and 50° more than any mere law of continuity would seem to require. A considerable portion of the deflection is attributable, I doubt not, to local causes. In fact, a considerable current is described as setting northward along that coast from about the 45th degree of latitude, which may probably account for this extra deviation. The remainder must be attributed to the influence of the Pacific Ocean, and would probably accord with the similar deflection which I have given to my hypothetical line as arising from a similar cause on the western coast of Europe.

Supposing the isothermal we have been considering to be correctly drawn for our hypothetical case, there can be no doubt, I conceive, of the approximate accuracy of the neighboring January isothermals as I have drawn them. In southern Asia they are compressed near to each other by the region of maximum cold which lies in the northeastern portion of Asia. As they approach the coast of western Europe they will necessarily become more dilated, as I have represented them.

12. Let us now examine the probable position of the isothermals for July in the hypothetical case of the non-existence of the Gulf-stream. These lines, it will be observed, as they now exist, have an extraordinary inflection to the north in northeastern Asia. As we proceed westward from that region, they take a direction considerably south of west, until they come under the influence of the anomalous temperatures of western Europe. This influence, however, does not sensibly extend so far southward in summer as in winter, on account of the higher temperature of the northern Atlantic in summer. The July isothermal

of 63°·5 F., which passes immediately south of London, seems not to feel it in any sensible degree. This isothermal, therefore, and all those to the south of it may be considered to have the same positions in our hypothetical case as in the existing one. Those immediately on the north of the isothermal of 63°·5 must necessarily be approximately parallel to it. We observe also, as these lines approach the coast of America, they suffer an anomalous deflection to the south, due, I imagine, to the polar current setting southwards along that coast from Davis's Straits, the warm season being that in which this cold current would be most felt. I have drawn the isothermals for our supposed case, as independent of these anomalous deviations, and such as their actual positions on the east and west of the region of these irregular influences obviously indicate. It would hence appear, that the Gulf-stream has no sensible influence on the July temperature of London, or of places in western Europe further to the south.

13. We are now prepared to estimate the effect produced by the Gulf-stream on the *mean annual temperature* of any assigned place. The following are the approximate numerical values of the temperatures for January and July, and the mean annual temperature, considered as the mean of those two temperatures, for the Alps, Snowdon, the northern extremity of Scotland, and center of Iceland; both for the present time, and for our hypothetical case, in which, it will be recollected, the configuration of land and sea is supposed to be the same as at present, but the Gulf-stream not to exist. The temperatures are all determined by Dove's map.

	At present, with the Gulf Stream.	Difference.	Without the Gulf Stream.	Difference.
THE ALPS.				
Temperature for January, . .	38° F.	35°	34° F.	39°
" " July, . . .	73		73	
Mean annual temperature, . .	55·5		53·5	
SNOWDON.				
Temperature for January, . .	38 F.	23	23 F.	38
" " July, . . .	61		61	
Mean annual temperature, . .	49·5		42	
NORTHERN EXTREMITY OF SCOTLAND.				
Temperature for January, . .	36·5 F.	19·5	12 F.	44
" " July, . . .	56		56	
Mean annual temperature, . .	46·25		34	
CENTRE OF ICELAND.				
Temperature for January, . .	30 F.	22	−4 F.	50
" " July, . . .	52		46	
Mean, ...	41		21	
Mean annual temperature,* . .	39			

* This is deduced from the mean of the monthly temperatures. The mean annual temperatures above given for the other cases is almost identical with those deduced from the monthly temperatures. The discrepancy of 3° in the case of Iceland may be attributed to local peculiarities.

14. The next case I have proposed for discussion is that in which the Gulf-stream should exist, with a barrier of land connecting Scotland with Iceland, and that island with Greenland. Since this barrier would intercept the influx of the Gulf-stream into the North Sea, it would very much reduce the temperature there, and in all the northern parts of Scandinavia. On the other hand, the waters of the Gulf-stream, being now confined to the northern part of the Atlantic, would considerably raise the temperature of that region. According to our preceding estimate, the present increase of mean annual temperature due to the Gulf-stream is as follows:—

18° F. in Iceland;	7°·5 F. at Snowdon;
12°·25 F. in the north of Scotland;	3° F. at the Alps.

The mean annual temperature on the south coast of Iceland is now about 40°. It is, I think, probable that this might be raised by 4° or 5° in the case supposed, which would make it approximate to the mean annual temperature of the English Channel. This effect on the mean temperature would be due principally to the effect on the winter temperature. If this latter were increased 6° or 7°, and the summer temperature 2° or 3°, the January temperature would be nearly uniform (or the January isothermal would run nearly north and south) from Iceland to the latitude of the Alps or central France. The January isothermal of 32° now runs north and south through an equal extent of latitude from a point several degrees north of the Arctic circle to the southern shore of the German Ocean. On the north of the barrier, on the contrary, the variation of temperature would be more rapid than at present.

15. The next supposed case is that in which the whole Atlantic, from the equator northward to Greenland, Iceland and the North Cape, should be converted into land. In this case there would be no reason why the isothermals should not preserve their parallelism, with the exception of merely local deviations, from points near the east coast of Asia to corresponding points near the west coast of North America. Let us first consider the January isothermal of 32° F. in the northern hemisphere.

If we take this line as drawn independently of the disturbing influence of the Gulf-stream, but supposing the Atlantic still to exist, it is characterized by a northward inflection as it approaches the Atlantic, due to the influence of that ocean. In the present case there is no reason for that inflection, and we may assume the isothermal to pass nearly in a straight line from the Black Sea to the point where the actual isothermal of 32° F. meets the coast of America. This will render its course nearly a straight line between the opposite coast of the single continent into which the two existing continents would be united in the case we are con-

sidering. Its course would be very nearly, but not exactly, east and west, reaching a rather lower attitude in Asia than in America, in consequence of the high tablelands of southeastern Asia.

The three succeeding existing isothermals to the north on Dove's map (those for 23°, 14°, and 5° F.) are very nearly parallel to that of 32°, and equidistant from each other through about 80° of long. in Asia, and through 30° of long. in N. America. In the intermediate space they are inflected to the north by the Atlantic. Their position in our present hypothetical case would doubtless be approximately determined by substituting straight lines across this intermediate space, for the actual inflected lines.

The present winter isothermals, north of those just mentioned, become more irregular in their course in eastern Asia, as well as in North America. In the former region the distance of successive lines from each other is somewhat less than in the latter, owing to the unsymmetrical position of the region of maximum cold, which, instead of being symmetrically situated round the north pole, inclines considerably towards north-eastern Asia. This position must be due, in great measure, I conceive, to the influence of the North Sea, warmed as it is by the Gulf-stream. In our hypothetical case this cause would be removed, and we may conclude that the region of maximum cold would be situated nearly symmetrically with reference to our one great continent, but inclined from the pole towards that continent, and from the great Pacific Ocean situated on the opposite side of the pole. The probable longitude of its central point would be nearly that of the present western coast of Europe. This would bring the isothermals in our hypothetical case, lying on the north of those already traced, into approximate parallelism with the equator between the eastern coast of Asia and the western coast of America. The distances between them (for such, at least, as should not be too far to the north) would necessarily be much the same as between those of which the positions have been previously discussed—the isothermals of 32°, and the three succeeding it to the north.

The approximate positions of the winter isothermals on the south of that of 32°, and in the northern hemisphere, may be easily inferred in like manner. It is not necessary here to discuss them in detail.

Let us now take the July isothermals for the northern hemisphere. In Asia there would seem to be no reason why they should differ materially in the present case from the actually existing lines. West of the meridian of 60° E. the two lines of 36°·5 and 41°, delineated on Dove's map, are manifestly affected by the Gulf-stream. The next to the south, that of 45°·5, together with the two succeeding lines, follow the inflection of the northern coast of Scandinavia, and must be considered as influ-

enced in a small degree by the same cause. If we place them a little more southward, but still allowing for the tendency of the slight northern projection of the continent in that region to inflect these summer isothermals to the north, their positions will be approximately correct for our supposed case. Further west we must destroy the southward inflections produced by the Atlantic, and continue the isothermals almost directly west to the most northern points through which the existing ones pass respectively in the northwestern part of N. America, about the meridian of 130° or 140° of W. long.

Again, the isothermal still more to the south may be considered as unaffected by the filling up of the Atlantic, at the points at which they meet the meridians of 60° E. long. (that of the Ural Mountains,) and at those of 100° to 120° W. long. Straight lines joining these respectively would represent the isothermals of the intermediate space independently of merely local variations.

Taking the same places as before, we have the following results in the case before us for their temperatures :—

	At present.	Difference.	Old and New Continents united.	Difference.
THE ALPS.				
Temperature for January, . .	38° F.	35°	14° F.	61°
" " July, . . .	73		75	
Mean annual temperature, . .	55·5		44·5	
SNOWDON.				
Temperature for Jauuary, . .	38 F.	23	−7 F.	73·5
" " July, . . .	61		66·5	
Mean annual temperature, . .	49·5		29·75	
NORTHERN EXTREMITY OF SCOTLAND.				
Temperature for January, . .	36·5 F.	19·5	−22 F.	84
" " July, . . .	56		62	
Mean annual temperature, . .	46·25		20	
CENTRE OF ICELAND.				
Temperature for January, . .	30 F.	22	−25 F.	78
" " July, . . .	52		53	
Mean annual temperature (deduced from the monthly temperatures),	39		14	

The isothermal of 32° F. would pass nearly through Madrid. The whole climate of western Europe would be converted into an extreme continental climate similar to that of northeastern Asia at present.

16. The last hypothetical case I propose to consider is that in which all the lower land of Europe should be submerged beneath the surface of the ocean. This tract would comprise all northern Europe except the mountainous parts of Scandinavia; nearly the

whole of Russia in Europe, extending southward to the Black Sea; together with Central and Western Europe as far as the Pyrenees, the Alps, and the Carpathian Mountains, except those limited ranges of higher land which might still protrude as islands above the surface of the ocean. This space is intended to include all that over which the sea of the period of the Northern Drift must once have extended (supposing the drift to be of submarine origin,) together with such further extension southward as may be rendered probable by the configuration of the existing surface of the land. I shall also assume the entire absence of the Gulf-stream. I shall consider hereafter the manner in which this great current may have been arrested, or diverted from its present course.

In discussing the positions of the isothermal lines for the northern hemisphere in this case, we may again commence with the January line of 32° F. There appears no cause for any material alteration in its position in southern Asia east of the meridian of about the 70th degree of longitude. To the west of that meridian the influence of the ocean extending to the Black and Caspian Seas would doubtless begin to deflect it towards the north, and probably somewhat more than I have supposed it to be inflected by the Atlantic, independently of the effect of the Gulf-stream. From the 30th or 40th degree of east longtitude it would proceed nearly west, but with a slight deflection to the south, arising from the influence of the land which we may suppose still to exist in Scandinavia, and also from that of the northern continent of Greenland. This would cause the isothermal to intersect the line of the existing French coast about its northwestern extremity, the point at which I have before supposed it to be intersected by the line of 32° F. in the absence of the Gulf-stream. In the region of North America the isothermal would depend on the manner in which the Gulf-stream should be diverted from its present course. The neighboring isothermals would follow the course of that of 32° with approximate parallelism. The July isothermals, which should traverse the sea that we are now supposing to extend nearly as far east as the Ural Mountains, would be deflected southward as they are at present on approaching the shores of western Europe. It will be observed that the July isothermal of 63°·5 intersects the January one of 32° (as I have drawn them for the case previously considered of the absence of the Gulf-stream) at a point very near the extreme western coast of Brittany (§ 11, p. 74.) Between this point and the meridian of the Ural Mountains, the January line would lie more to the north and the July one more to the south, by the influence of the extended ocean. The effect, therefore, would be to equalize in a greater degree than at present the summer and winter temperatures of the tract in the vicinity of the European portions of these lines, but probably without producing any material changes in its mean

annual temperature. This tract may be considered as comprising the whole of Central Europe, together with its western portion from the Pyrenees to the southern shores of the Baltic. It is the region in which the geologist is more especially interested in tracing the climatal influences of changes in the configuration of the earth's surface. I shall therefore endeavor to ascertain from more general considerations the probable effect of an extended ocean on the *winter*, the *summer*, and the *mean annual temperatures* of the region in question.

17. For this purpose I have deduced from Dove's map the following results respecting these temperatures for the 20th, 30th, 40th and 50th parallels of latitude in both hemispheres. Each result given for January is the mean of the January temperatures for all places situated under the corresponding parallel of latitude; and each result for July is a similar mean for the July temperatures. The mean of these is assumed to be the approximate value of the mean annual temperature of the different parallels respectively:

Mean Annual Temperatures of different Parallels of Latitude.

Lat.=20° N.		Diff.	Lat.=20° S.		Diff.
January mean temp.	68 F.	14°	January mean temp.	78 F.	9°
July " "	82		July " "	71	
Mean annual temp.	75		Mean annual temp.	74·5	
Lat.=30° N.			**Lat.=30° S.**		
January mean temp.	58 F.	20°	January mean temp.	75 F.	12°
July " "	78		July " "	63	
Mean annual temp.	68		Mean annual temp.	69	
Lat.=40° N.			**Lat.=40° S.**		
January mean temp.	37 F.	35°	January mean temp.	58 F.	9°
July " "	72		July " "	49	
Mean annual temp.	54·5		Mean annual temp.	53·5	
Lat.=50° N.			**Falkland Islands.* Lat.=50° S.**		
January mean temp.	16 F.	46°	January mean temp.	34 F.	18°
July " "	62		July " "	52	
Mean annual temp.	39		Mean annual temp.	43	

We may first remark the striking equality of mean temperatures in corresponding parallels north and south of the equator as far as the 40th degree of latitude. The small differences indicated by the above numbers are not to be regarded, because they lie within the limits of error to which the numbers themselves must necessarily be subject. In the latitude of 50° N. the severe winter cold of Eastern Asia and that of the central portions of the North American continent reduce the mean temperature to more than 4°

* The isothermal lines for this southern latitude on Dove's map are continued only for short distances to the E. and W. of the Falkland Islands, so that the temperatures here given must not be depended upon for the mean temperatures of the parallel of 50° S. They are probably not far wrong, on account of the great regularity of the neighboring isothermals.

lower than that of the Falkland Islands in 50° S. latitude. But there are only a few observations recorded either of the January or the July temperatures along that southern parallel.

There is, on the contrary, a striking contrast between the northern and southern hemispheres with respect to the difference of summer and winter temperatures. These differences are in all cases considerably greater, and in the higher latitudes much greater, in the northern than in the southern hemisphere.

From these results it would appear, that the greater or less extent of land or sea has very little effect upon the mean annual temperature of an entire parallel of latitudes from the equator to about 45° degrees of latitude; and that beyond that parallel the predominance of land diminishes, while that of sea increases the mean annual temperature. Also, that a predominance of sea, in all cases, but especially in the higher latitudes, produces a greater equality of summer and winter temperatures.

18. Again, let us compare the temperatures of different stations along the same parallel of latitude, some of these stations being centrally situated as regards the continents, and others as regards the sea. It should here be remarked that the temperatures of the stations in the Atlantic for the 40th and 50th degrees of latitude must be regarded as partly hypothetical, because I have estimated them independently of the influence of the Gulf-stream. The following table embodies the results, deduced from Dove's map, for different stations on six parallels from that of 20° S lat. to that of 50° N. lat. inclusive:

Parallel of Latitude.	Longitude.	Temperature.			
		January.	July.	Difference.	Mean.
	°	°	°	°	°
20° S. . .	23 E. Land, . .	78 F.	71 F.	7 F.	74·5 F.
	20 W. Sea, . . .	74·5	67	7·5	70·75
	56 W. Land, . .	78	68	10	73
	140 W. Sea, . . .	77	74	3	75·5
10° S. . .	23 E. Land, . .	78	75	3	76·5
	20 W. Sea, . . .	77	74	3	75·5
	56 W. Land, . .	78	75	3	76·5
	140 W. Sea, . . .	78	77	1	77·5
20° N. . .	30 E. Land, . .	65	91	26	78
	40 W. Sea, . . .	71	76	5	73·5
	150 W. Sea, . . .	71	78·5	7·5	74·75
30° N. . .	30 E. Land, . .	56	81·5	25·5	68·75
	40 W. Sea, . . .	59	73	14	66·25
	150 W. Sea, . . .	62	72·5	10·5	67·25
40° N. . .	48 E. Land, . .	32	79	47	55·5
	40 W. Sea, . . .	44	68	24	56
	90 W. Land, . .	31	75	44	53
	170 W. Sea, . . .	54	59	5	56·5
50° N. . .	80 E. Land, . .	0	71	71	35·5
	30 W. Sea, . . .	26	61	35	43·5
	90 W. Land, . .	0	61	61	30·5
	150 W. Sea, . . .	35	53	18	44

On examining this table, we remark that in latitude 20° N. or 20° S., the mean of the temperatures of the land stations exceeds the mean of the sea stations; and in latitude 30° N. there is a similar small excess. In latitude 40° N. there is no sensible excess, and in latitude 50° N. the mean of the two land stations is about 10° less than that of the sea stations. It would thus appear that the effect of continents within the first 40° of latitude has the effect of increasing slightly the mean annual temperature of the most central parts of such continents, although it would appear from the previous table (§ 17, p. 82) that the existence of such continents within the above latitude has no appreciable effect in elevating the mean annual temperature of the whole parallel. The depression of the mean annual temperature at the land stations, compared with that of the sea station, in latitude 50°, is large. We might hence be led to conclude that a diminution of land and increase of sea along that parallel, such as would result from the depression of Europe beneath the ocean, would be attended with a considerable increase in mean annual temperature in the region thus become sea. This effect however would be very different in different continental regions along the same parallel. The effect would be greatest in the most central parts of the continent, and least in the vicinity of its bounding shores. To find the effect of the submersion of Europe, we may compare the mean annual temperatures at the two sea stations already given on the parallel of 50° with two other land stations on that parallel, one in western Europe (long. 10° E.) and another in eastern Europe (long. 30° E.) The temperatures of these stations (assuming always the absence of the Gulf-stream) will be—

	Long. 10° E.	Diff.	Long. 30° E.	Diff.
	°	°	°	°
January temperature, ...	25	40	14	54
July temperatue, ...	65		68	
Mean, ...	45		41	

The mean of 45° and 41° is 43°, which is not 1° less than the mean of the two sea stations of the same latitude. This tends to prove that the conversion of Europe into sea would have little effect on the mean annual temperature of those portions of it which lie contiguous to the parallel of 50° latitude, and especially in western Europe, the region, for instance, lying between the parallels of the Alps and the southern shores of the Baltic. At the same time the winter temperature would be increased and that of summer diminished to an equal amount, since their mean remains the same. If we suppose the change in each of these temperatures to be 4° for the station above-mentioned (long. 10° E.), we shall have for that station,—

		Diff.
January temperature, ...	29°	32°
July "	61	
Mean, ...	45	

At Snowdon, from its greater proximity to the ocean, this change in the summer and winter temperatures will be less. If we suppose it to be 2°, we shall then have for Snowdon (see Table, § 13, p. 77,)—

		Diff.
January temperature, ...	25°	34°
July "	59	
Mean, ...	42	

This latter mean annual temperature is about 2° higher than that of the south coast of Iceland (see Table, § 13, p. 77.) The difference of summer and winter temperatures, 34°, is greater than for Iceland, where it may be stated generally to be about 18° or 20° only. This actual case, however, presents a good standard of comparison for our hypothetical case. The Falkland Islands, situated in lat. 50° S., and the island of S. Georgia, in lat. 54° S., furnish also good standards of comparison. The conditions of the station above mentioned in western Europe (long. 10° E.), and Snowdon, of which the latitude is 53° N., would, in the case we are discussing (that of the absence of the Gulf-stream, and the submersion of Europe), far more resemble the actual conditions of all the above places than they do at the present time. We have for the Falkland Islands,—

		Diff.
January temperature, ...	52°	18°
July "	34	
Mean, ...	43	

This is less by 2° than the estimated mean temperature for the corresponding place (long. 10° E.) in N. lat.; the difference between the winter and summer temperatures is here less by 16° than in the other case. Again, we have for the island of S. Georgia (lat. 54°),—

		Diff.
January temperature, ...	45°	14°
July* "	31	
Mean, ...	38	

Here the mean temperature is 4° less than the estimated mean temperature of Snowdon; and the approximation to uniformity of temperature throughout the year much greater.

The table given above (§ 17, p. 82) shows the tendency, as I have already remarked, of the predominance of sea to equalize the summer and winter temperatures; and this is in accordance with the fact that there is a greater equality of those temperatures in the Falkland Islands and S. Georgia, than in the corresponding north-

* This temperature is not very certain, even should the map be exact, since there is no July isothermal given in the southern hemisphere quite so far south as South Georgia.

ern latitudes. It also appears from the table just referred to, that for the latitudes there given above 40°, the mean temperature for a whole parallel of latitude is higher in the south than for the corresponding parallel in north latitude. Now if this be due to the predominance of sea in the southern, and of land in the northern hemisphere, it would appear that the mean annual temperature of a *sea* station on the parallel of 50° N. latitude, would not exceed that of a similar sea station in equal S. latitude, unless the temperatures should be materially influenced by local causes. Hence the lower temperature of the Falkland Islands, as compared with that of the corresponding northern parallel, must be due either to local influences, or to too high an estimate of the mean annual temperature in western Europe in the hypothetical case of the absence of the Gulf-stream. I am disposed to attribute it to the latter reason. The temperature of the Falkland Islands may be depressed by a southern continent not very distant from them, and by consequent accumulations of ice; but it would seem that the region of western Europe about the parallel of 50° would, in the absence of the Gulf-stream, be liable to an equal similar influence from the Scandinavian region. I am disposed, therefore, to think that the isothermal lines for this case, represented on the map, ought to meet the coast of western Europe at points rather more southerly, so as to indicate temperatures for each locality about 2° or 3° lower than those now indicated. I might have made this correction on the map, but, as the determination of the positions assigned to these isothermals was entirely independent of any comparison with places in the southern hemisphere, I have thought it better to allow them to remain, as a proof of the approximate accordance of results arrived at by independent considerations. These corrected positions of the isothermals would assign to Snowdon, in the absence of the Gulf-stream, a mean annual temperature of 39° or 40°.

19. In more northern latitudes than that of Snowdon, our foregoing reasoning would lead us to conclude that the mean annual temperature would be increased by the submergence of Europe, but only in a comparatively small degree for insular stations and those situated immediately on the shores of the Atlantic. The temperatures, therefore, of the northern extremity of Scotland and of Iceland, under our present hypothesis, may be taken somewhat greater than those given in the table of § 13, p. 77, for the case in which the absence of the Gulf-stream was assumed. The temperature of the Alps would probably differ little from that given in the same table. The correction mentioned in the preceding paragraph, if adopted, must, of course, be applied also to these temperatures.

(*To be continued.*)

ART. XIV.—*The Relations of Cells to the Physical and Teleological views of Organization;* by W. I. BURNETT, M.D., Boston.

THE cell is the fundamental unity of organized forms. It is the chosen material form through which organization gains its first expression. To use a metaphor, it is the only altar on which life and matter are married, to pursue together a common and definite end.

These premises being true, as all modern inquiry clearly proves, we can justly seek from a study of this cell, a manifestation of all the conditions of organization, as far as they are capable of being made evident through material forms. We can also expect, by a consideration of these conditions, to be able to comprehend the higher and ulterior relations of organization as occurring in permanent individual forms.

Two dissimilar views of the real nature of organization have been urged in modern times.

That the bearings of the subject in question may be fully understood, a brief description of both of these views is here required. The first is, that every individual organism exists in virtue of a predominant idea: this idea, therefore, preceded the organism, of which this last is the true material manifestation. Organisms are, therefore, if I may so express myself, the incarnations of preëxistent ideas in nature. An organized form is simply a colligation of molecules of plastic matter occurring under the direction of a determinate idea or force. This force must, it is evident, be peculiar and differing from any belonging to matter generally. It is an immaterial one, and can be likened to no other in nature with which we are acquainted. In its conception we should not confound it with our idea of life; for between them a broad distinction can be drawn.

Thus, our idea of life is necessarily connected with, and dependent upon, that of organization; because, from the limitations of experience, we have not, and cannot conceive of it as a distinct and separate entity. On the other hand, our conception of this determinate idea, or that of the *individuality* of organization, although involving some of the same data as that of life, occurs from relations sufficiently dissimilar, to show well its distinction. Thus, while our idea of life is only *coëxistent* with that of organization; our idea of this individuality is not only *coëxistent*, but necessarily preëxistent to it. We do not comprehend life except in conjunction with matter under peculiar forms; on the other hand we conceive of this determinate idea or individuality as existing before a trace of organization appears.

This view of organization, which widely separates the organic from the inorganic world, as we can comprehend each through the expression of their forces;—which gives an inherent dignity to individual existence, because there is always an end in view,—this view of organization, I repeat, is called the *teleological* one.

The other and second view is fundamentally different. Adopting it, one does not recognize that the forces of organized are more in number, or different in character from those of unorganized matter;—the fact of organization being due to a certain combination of powers possessed by all material forms. And when this combination has once taken place, there necessarily results, in virtue of it and the forces impressed on matter in its beginning, a certain end which is called individual existence. The common phenomena of organization, therefore, are due to the blind working of the laws of necessity, and which are irrespective of any purpose; they also involve no conditions excepting those properly belonging to Chemistry and Physics.

According to this view also, the so-called "individual adaptation" does not result from a determinate idea seeking an expression, but rather ensues from a combination of blind forces, which the Deity impressed upon matter in the beginning. Design in nature, therefore, is only another set of terms for necessity of physical condition. Again, when we see the habits and conformation of an animal *suited* to the circumstances under which it is found, we are not to attribute this to an idea preëxisting all, and thus seeking its material expression; but are to regard the whole in the light of a necessity; for the very fact of the existing state of conditions implies that, were they different, the animal would not exist; and therefore the very data we reason from, determine the idea of necessity as far as justly applicable to works of an almighty power.

This view of nature which ranges all its phenomena under the domain of physical forces, thus giving, in one sense, the same dignity to inorganic as to organic forms,—this view of organization, I repeat, is called the *physical* one.

In this brief description of these two widely dissimilar views of organization, I may have failed to express clearly the grounds of their distinction; for nothing is more difficult than the successful expression of the exact definitions of mere modalities of matter. In a laconic and perhaps comprehensive form, I would say that the *teleological* view is the full definition of *Development;* while the *physical* view is the equally full definition of *Combination.*

We will now turn to the arguments for and against each of these views, at least as far as dependent upon cell-studies.

The first question is, does the adaptation perceived in the organic, differ in character from that perceived in the inorganic

world? An affirmative answer must, I think, be given to this question. The adaptation seen in the inorganic world has reference only to existing circumstances, and the only surety of its continuation is in the persistence of the forces on which it depends. Such, for instance, is that of the planetary system. It is properly called an adaptation only in virtue of the existing harmony found. But this harmony, however perfect, indicates no definite end, which is the final reason of its existence.

On the other hand, with organic nature, other and different relations are seen. For besides the adaptation just spoken of, and which conduces to its general harmony with matter, there is superadded an *individual* adaptation of the whole, for an end, seemingly in view from the beginning. Indeed, we can truly say with Kant, that this end constitutes the very definition of an organized form.

In all our investigations into the structure of animals and plants, we involuntarily (in one sense) proceed upon the principle that *nothing was made in vain*. If at any time we have even a misgiving of the whole truth of this principle, our scientific ardor, as hopeful of real results, is immediately relaxed, not to say harmed. This involuntary admission of a doctrine, shows how secretly yet how firmly is our mind, in its study of natural phenomena, linked with the *teleological* view of organization.* We cannot free ourselves from it, any more than we can free ourselves from the silent yet constant admission of the truth of the great physical doctrine that *nothing comes by chance*. This question, therefore, which I have put, might well seem not only superfluous, but highly unphilosophical But I was led to commence with it from the fact that a very sagacious mind,† thinks it correctly answered in the negative. We will, however, pursue this subject a little farther. I have said that the adaptation of the inorganic world has reference to existing circumstances only, while that of the organic world beside being individual, has always reference to events or contingencies of the future. This point is well illustrated in the phenomena of reproduction.

When animals were first created, the footing on which they commenced life, was the same in each. But why, accepting the *physical* view of organization, were their powers of reproduction formed exactly in accordance with their probabilities and liabilities of existence, as all zoological experience constantly shows

* I think it may be truly said that the strength and ever-constant presence of this principle in the minds of great naturalists, has been the grand secret of their success. That this is so the instances of many notable men, might be adduced. In the case of Cuvier this was preëminently true, and it served as an ever-faithful intuition to open to him domains of knowledge hitherto untrodden. There is another naturalist now living, whose splendid labors, as I know personally, have been based upon this same principle.

† Schwann, *Mikroscop. Untersuch.* &c., or Sydenham Soc. Ed., p. 187.

is true? It is the characteristic of physical forces that they act upon the conditions of the time, and no physical force can act on the probability of future contingencies. The amount of animal and vegetable life on the earth's surface, in localities not disturbed by human or other agencies of an accidental nature, has not changed for an indefinite period of time. In those places the mutual relations of animals and vegetables exist now as we have reason to believe they did in the beginning.

There is no evidence that there has hitherto been a constant oscillation, and that the present rest and harmony is one ultimately and necessarily gained. Now in all these animals and plants, we find their reproductive powers, the capacity of their organs of generation, exactly in accordance with their liabilities to destruction. Were this the place, the truth of this remark might be illustrated by many special instances. But it is evident that by this almost prescient adaptation, the numerical relations of species are preserved unchanged; and those who are familiar with the leading results of zoological research at the present day, can scarcely entertain this subject in the light of a question.

The next point of discussion is, whether, admitting organization to exist always in virtue of determinate ideas, it is not unphysical and unphilosophical to assert, as we must, that these ideas or peculiar forces exist previous to the material forms in which they are ultimately expressed? This question is so specious that at first an affirmative answer appears to be the only correct one. But a little consideration will, I think, show its error. Our knowledge of physical phenomena is derivable from observation only; and when points are urged upon us which we have not observed, and which also do not seem compatible with hitherto existing observation, they are liable to be pronounced unphysical. But the history of any of the inductive sciences has shown that the singularity of any hypothesis or opinion, concerning physical phenomena, is no *a priori* argument against its truth. This remark is aptly true of the present case. The hypothesis that matter should have determinate ideas not expressed by physical phenomena at the time, but which are latent, and are to be developed under special forms in future, this hypothesis, I repeat, should not be rejected on the ground alone of its singularity; and much more will it be admissible if its singularity can be disproved. This disproval may be found, I think, in the numerous analogous phenomena of generation. Here we are driven to the admission of the existence of forces, long before the formation of the materiai organs, in which they ultimately find their expression.

Take, for instance, the *cicatricula* of a robin, and that also of a hawk; physically they resemble each other exactly, and no microscopical analysis can detect between them any material dif-

ference. Yet no one will pretend to deny that in the one lies concealed all that belonging to a robin, and in the other all that belonging to a hawk. This will bear no other interpretation. Here you have very dissimilar powers and forces in apparently identical material forms; and unless we declare that these different powers and forces existed before and aside from the material form, instead of gradually accruing to it, as a particular character was assumed, we shall be at a loss to account for the certainty and uniformity of result in every case. Again, the primordial material condition of every animal is a nucleated cell, which in every case has exactly the same physical aspect. Now in its growth to the perfect form, the new material constantly added is is extraneous, and there would appear no reason why it should always suit the conditions of the case, were there not an underlying, preëxisting idea. Indeed we might expect an occasional blending of dissimilar forms. But this never occurs, and few points connected with organization have been more positively determined, than the distinct, unchanging individuality of animal and vegetable types.

If this point needs further illustration, or even that which is better, we can find such in the male phenomena of generation. It may be well to discuss briefly a few of these points.

Within a few years, three prominent facts have been satisfactorily established concerning the function of the spermatic particles. These are, 1st, That they are the only fecundating particles of the semen. 2nd, That a single individual particle is sufficient to fecundate a single ovum. 3rd. That the physical phenomena of fecundation are those of simple contact alone, of the spermatic particle with the ovum; there being no material loss on the part of the former.

We know very well how important and active a part the male plays in the production of the new being, and I scarcely need add that the offspring partakes equally of the physical peculiarities of both parents. But in no way can it receive those of the father except through the medium of the spermatic particles. And so, however strange it may appear at first, yet the conclusion is irresistible, that a single spermatic particle must contain, concealed within it, not only the general physical peculiarities of the father, but mental dispositions also, and as is too often true of our own species, morbid taints superadded to all.

The third and last point in the discussion of this subject, is the objection to the teleological view of organization urged by Schwann,* and that too, concerning the general phenomena of the subject we have just left—generation. I will quote the entire passage that there may be no misapprehension of the idea in-

* Loc. citat., Syd. Soc. 2d., p. 189.

tended to be conveyed. He says: "If we assume each organism to be formed by a power which acts according to a certain predominant idea, a portion of this power may certainly reside in the ovum during generation; but then we must ascribe to this subdivision of the original power, at the separation of the ovum from the body of the mother, the capability of producing an organism similar to that which the power, of which it is but a portion, produced: that is, we must assume that this power is infinitely divisible, and yet that each part may perform the same actions as the whole power. If on the other hand the power of organized bodies resides, like the physical powers, in matter as such, and be set free only by a certain combination of molecules, as for instance electricity is set free by the combination of a zinc and copper plate, then also by the conjunction of molecules to form an ovum the power may be set free, by which the ovum is capable of appropriating to itself fresh molecules, and these newly-conjoined molecules again by this mode of combination acquire the same power to assimilate fresh molecules." Schwann is here evidently urging the doctrine of catalysis in organic forms. This same doctrine has lately been pushed to its limit for similar reasons, by Mulder.*

And thus it would appear that some, in the study of organic phenomena, are willing, rather than appear what they call "unphysical," to summon to their aid the blindest physical forces, instead of admitting the existence of those which are special and distinct, and constantly urged upon them. The prominent objection Schwann urges, is the physical absurdity that the division of a power or force does not decrease it.

But this is falling back upon the properties of physical forms only, in which the mathematical axiom that *a part is less than the whole* is true. But it is the peculiarity of immaterial agents that they cannot be subject to the same definitions as those of a material nature. We have yet to escape from a strange confusion of ideas on these points, and when considering these higher forces, we must not tacitly deny their higher and immaterial character, by subjecting them to material definitions. For, on these grounds, the very existence of that of which we feel most certain, namely, *thought*, might well be denied. In fact, I think many of us have yet to learn that the mathematical axiom above quoted, holds true of the immaterial agents.

Perhaps this remark is true even of electricity, for in the phenomena of *catalysis*, we witness the transference of force or quality without an apparent loss from the body, from which the

* The Chemistry of Vegetable and Animal Physiology. English Trans. Edinb., 1849, pp. 28, et. seq.

transference takes place.* To urge that that only which is substantial can be transferred, is to reason on the ground that a phenomenon in nature is impossible because it eludes our observation and analysis.

In the phenomena of generation we certainly have proved to us that there may be a division of power or quality without a real loss; in other words that there may be an indefinite number of divisions and yet each of these possess the capability of the whole from which the division was taken or made.

Thus, as I have before said, the spermatic particle is the potential representative of the whole male being. It contains within it the totality of the peculiarities of the individual in which it has been formed. These spermatic particles are constantly formed, and in the case of any of the higher animals, literally millions are yearly evolved; yet each possesses the powers of the other, and of the whole animal: and the animal certainly loses none of its individuality by such a constant division.

The objections of Schwann, to the teleological view of organization, are therefore, more specious than valid, because the reality of the very conditions objected to has an expression in quite common phenomena.

These same teleological views might be shown to be almost imperatively forced upon us by a general review of developments imperfectly attained,—the subject of monstrosities. Here you not unfrequently have conditions of organization, in which imperfections of physical form, reveal distinctly the perfection of the underlying determinate idea of organization.

In special cell studies connected with the subject of generation, however, as we have seen, these doctrines of teleology find their most unequivocal support.†

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* In regard to this point, Mulder (Loc. cit.) takes a different view. He thinks that in the case of a magnet magnetizing a piece of iron, there is no *transmission* of force, but simply an awakening of slumbering forces in the iron. It might well be asked if this makes the matter any more clear? You are obliged on this supposition to admit the existence of *latent forces* in the iron, and this is "unphysical" according to his own admission. Mulder says, "A weak force is strengthened; it is impossible to imagine the transference of a force from one material mass to another." But, is it not truly "unphysical" to suppose that a weak force can be strengthened except by the *addition* of new force?

† It may be urged that in all cases it conduces much more to the object of science to strive, at least, to adopt the *physical* instead of the *teleological* explanation of the phenomena of organic life. This is so because it leads us in our investigations rigorously to exclude the admission of those various hypothetical forces and conditions, which ultimately serve as an universal refuge in the instances of inexplicable phenomena. On the other hand, if we seek to base all phenomena on physical grounds, we tend to exclude the admission of conditions not having their corresponding expression in physical forms. This objection therefore rests rather upon our liability to error in interpreting natural phenomena, than upon real grounds. It must be regarded in the light of a necessary *caveat* connected with the fallibility of our intellect. There is, however, as we have seen, a danger, that in endeavoring to be strictly *physical* we may become highly "unphysical," not to say unphilosophical.

In conclusion, I think it may be truly said that one of the tendencies of the most intimate physiological, microscopical studies of the present day, is to show the inadequacy of microscopic and chemical investigations to detect physical differences in structures essentially dissimilar. Once appreciating this fully, we are prepared for the ulterior doctrine, that in organization, matter is but the vehicle for the phenomenal manifestation of determinate ideas, which last only, therefore, have an objective reality.

ART. XV.—*A Method of getting rid of Sal-ammoniac in Analysis;* by Dr. J. LAWRENCE SMITH.

THERE is nothing in mineral analyses more embarrassing than the accumulation of sal-ammoniac towards the end of an analysis, especially where potash and soda are to be estimated. The only method now adopted to get rid of this ammoniacal salt, is to volatilize it by heat, which, if the quantity be considerable, is attended with no little annoyance, and a certain loss of more or less of the fixed alkalies which may be present. I have within the last twelve months discovered a method of overcoming that difficulty, and much experience during that time has proved that it is of considerable value. The method is simply to add nitric acid to the solution containing the sal-ammoniac and alkalies, and heat it gently over a lamp or sandbath in a glass flask or porcelain capsule. The nitric acid may be added either before the liquid is concentrated or after concentration; a most quiet decomposition ensues, and the liquid readily evaporates to dryness leaving nothing but the fixed alkalies if they be present. I am in the habit of using a little more than three grammes of pure nitric acid of ordinary strength to every gramme of sal-ammoniac supposed to be present in the liquid. The exact nature of the decomposition which ensues cannot now be stated, but there is doubtless formed besides other things—chlorine, hyponitric acid and nitrogen. I shall not enter more into detail about this method, as I intend at a future time to do this; only wishing at present to take precedent in what I presume a method of some importance in analytical chemistry and never to have been used before for this end.

ART. XVI.—*Description of a Brown Coal Deposit in Brandon, Vermont, with an attempt to determine the Geological Age of the principal Hematite Ore Beds in the United States;* by EDWARD HITCHCOCK, D.D., LL.D., President of Amherst College, and Professor of Geology.

IN the autumn of 1851, Professor Shedd of Burlington, presented me with a few specimens of beautifully preserved fruits from Brandon, Vermont. They were converted into Brown Coal, and retained exactly their original shape and markings. Early in the spring of 1852, I visited Brandon, and found that the fruits were obtained from a bed of Brown Coal connected with the white clays and brown hematite of that place. I perceived at once that an interesting field was open before me: and ever since I have been endeavoring to explore it. Great difficulties presented themselves; and I have resorted to several gentlemen, both in this country and in Europe, for aid. Their opinion has yet been obtained only in part. But there are several points of much interest to American geology, cleared up by what I have already ascertained. I have concluded, therefore, to give a brief account of this case; hoping hereafter to make additions to it.

I would here acknowledge my deep indebtedness to John Howe, Jr., the proprietor of this deposit of iron, clay, and brown coal. Not only did he do all in his power to aid my investigations upon the spot last spring; but since then he has sent me, free of expense, numerous specimens of the fruits and the coal; especially at one time two barrels of the coal containing the fruits, and at another time, a gigantic mass of lignite,—the trunk of a large tree in fact, which is now deposited in the cabinet of Amherst College.

I shall first give a description of the topography and geological associations of this carbonaceous deposit: next an account of the lignites and fossil fruits; and finally deduce from the facts some geological inferences of importance.

I. *Topography and Geological Associations.*

Geologists are aware that along the west base of the Green and Hoosac Mountains from Canada to New York occur numerous beds of brown compact and fibrous hematite iron ore. That in Brandon lies between two and three miles east of the village. Passing easterly from the village, the surface rises slightly, and exhibits clay, drift, and limestone rock in place. According to my measurements with the aneroid barometer, Brandon village is 465 feet above the ocean, and the iron mine 520 feet above the same. A short distance east of the mine, the Green Mountains rise rapidly.

At this spot we find the following varieties of substances in juxtaposition:

1. Beautiful kaolin and clays colored yellow by ochre, rose-color by manganese, (?) and dark by carbon.
2. Brown hematite and yellow ochre.
3. Ores of manganese.
4. Brown coal.
5. Beds of gravel connected with the clays.
6. Drift, overlying the whole.
7. Yellowish limestone, underlying the whole.

The position of the clays it is difficult to determine exactly, as there seems to have been a good deal of disturbance of the strata, perhaps only the result of slides. The iron is generally found beneath the clay, as is also the manganese. The coal in a few places shows itself at the surface. In one spot a shaft has been carried through it, only a few feet below the surface, and the same has been done to the same bed nearly 100 feet below the surface. In both places it is about twenty feet thick. I found it to be the conviction of the miners that this mass of coal forms a square column of that thickness, descending almost perpendicularly into the earth, in the midst of the clay. My own impression was, that it is a portion of an extensive bed, having a dip very large towards the northwest; perhaps separated from other portions of the bed by some disturbance of the strata. But I found great difficulty in tracing out its exact position.

It ought to be mentioned that no unstratified or igneous rocks are known to exist in the vicinity of these deposits; nor do they exhibit any marks of the metamorphic action of heat.

II. *Coal, Lignite and Fossil Fruits.*

The greater part of the carbon of this deposit is in a condition intermediate between that of peat and bituminous coal. It is of a deep brown color, and nearly every trace of organic structure, save in the lignite and the fruits, is obliterated. Disseminated through it are numerous angular grains, mostly of white quartz, rarely exceeding a pea in size. It burns with great facility with a moderate draught, and emits a bright yellow flame, but without bituminous odor. After the flame has subsided, the ignited coals gradually consume away, leaving, of course, a quantity of ashes. It is employed to great advantage in driving the steam engine at the works; and I should think it might be used advantageously for fuel in a region where wood is scarce, which is not the case at Brandon.

Interspersed through the carbonaceous mass above described, occur numerous masses of lignite. In all cases which have fallen under my observation, they are broken portions of the stems or branches of shrubs and trees, varying in size from that of a few lines to a foot and a half in diameter. They all appear to

me to have been drift wood. The largest mass which I have seen, and to which I have already referred as sent me by Mr. Howe, resembles exceedingly a battered piece of flood-wood; which led Mr. Howe humourously to inscribe upon the box in which it was sent, "*A piece of flood-wood from Noah's Ark.*"

This lignite in all cases retains and exhibits upon a fresh fracture, its organic structure. Yet generally it is quite brittle, and when broken across the fibres it has the aspect of very compact coal, which admits of a good polish. In some specimens the original toughness of the wood is not quite lost, and the aspect of the wood remains.

The large mass of which I have already spoken, as now in the cabinet of Amherst College, is four feet long and sixteen inches in its largest diameter. It is considerably flattened, but seems to have been so originally. In the peaty matter that adheres to it, I noticed several specimens of fruit, and more than one species.

With perhaps one or two exceptions, all the lignite of this deposit belongs to the exogenous or dicotyledonous class of plants. In general the texture is close, and some of the wood is very fine grained and heavy. The bark is often quite distinct. I have been inclined to refer some of the wood to the maple; yet probably a good deal of it is coniferous: but my microscopic examinations on this point have not been as satisfactory as I could wish. I do not think much of the wood belongs to the pine tribe now common in this latitude. I have placed specimens in the hands of several distinguished vegetable physiologists, and had hoped ere this to learn their opinion; but they have not yet given it.

The fruits and seeds of this deposit are the most interesting of the relics found in it. But they are even more perplexing than the lignite. As yet I hardly dare venture to refer any of them to living or fossil genera known to me. I shall, therefore, merely present figures of the principal distinct forms which I have obtained, and leave a minute description to some future occasion.

1.

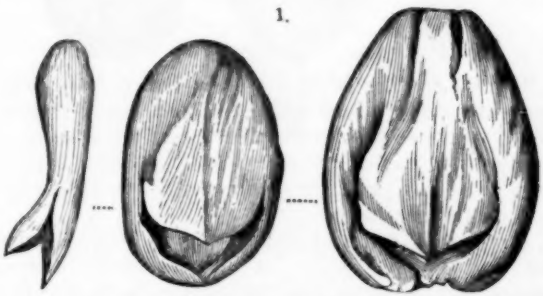

Fig. 1 exhibits the most common fruit, both flatwise and edgewise. It is always thus flattened; and when dried, the two

valves exhibit the dehiscence in the figure. These valves are made up of fibrous matter; the fibres lying perpendicular to the surface. The seed is always wanting, but the thin membranous integument once enclosing the seed, often remains. There is considerable diversity in the size and form of these fruits. The figures represent one of middle size and one of maximum size, as well as one placed edgewise. Of this variety I have obtained several hundred specimens.

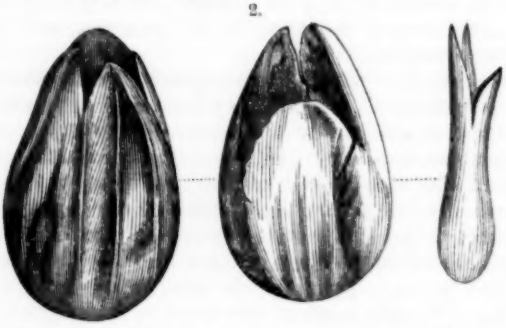

Fig. 2. This is a rare variety of fruit, differing from the last in being more acuminate, in being ridged upon its lower side, and in opening more or less by three valves; yet two of them are more distinct than the other. I have found only two or three specimens; but they are certainly specifically, and most likely generically, different from the last. The figures show both the upper and under side as well as the edge.

Fig. 3. This species differs from the last in being less acuminate, more distinctly ridged on both sides, much thicker at the upper end, when seen edgewise, and rarely dehiscent. I have found only a few specimens, and those of variable size.

All the preceding pericarps are fibrous perpendicular to the surface, and destitute of a seed.

Fig. 4 represents a not unusual form which was most probably a berry: for on breaking it, it appears nearly homogeneous throughout, and the outer integument is quite thin: yet it shows seven quite distinct meridional lines in distinct relief, sutures as I suppose, though indehiscent. It bears a good deal of resem-

blance to some species of walnut, but there is no nut within. Its surface is considerably rough and pitted.

Fig. 5 differs but little from fig. 4, except that it is smoother, the sutures are less distinct, and form grooves rather than ridges, and the divisions are usually six. It evidently belongs to the same family of plants as fig. 4, and perhaps it is only a variety. These forms are somewhat common. I think I have found not less than two hundred specimens.

Fig. 6 is in the form of a prolate spheroid, whereas figs. 4 and 5 are almost exact spheres. They all, however, have essentially the same internal character. All have the same thin outer covering, and (with an exception mentioned below) retain the precise form which they had when hanging upon the plant or tree, on which they grew; and the place of attachment for the stem is usually quite obvious, as well as the apex. The internal part of the fruit is usually homogeneous; but I can not discover seeds at all, nor much evidence of cells. The meridional lines on this species are usually six.

Specimens of the last three varieties are sometimes considerably flattened, but in no case have I noticed that the carbonization has diminished the size.

Fig. 7 exhibits a section of a single carpel, which is sometimes developed by breaking open a species of fruit similar externally to fig. 4, except that the sutures are wanting. But in fig. 7 the epicarp is quite thick. The carpel very much resembles that of the Ricinus communis, or castor oil plant.

Figs. 8 and 9 were taken from specimens resembling in appearance and internal character figs. 4 and 5, and very probably the fruits from which they are taken are only varieties of figs. 4 and 5, in which the apex is very much aside from the pole of the geometrical axis,—so near the base or stem, in fact, that I am in doubt whether they are not leguminous seeds. But I find examples of almost every intermediate degree of obliquity in this respect.

There is a strong resemblance between these distorted fruits, and those of many species of palms, as figured in Von Martius's

great work on that family. And had I been able to detect any monocotyledonous wood among the lignites of this deposit, I should be inclined to refer some of the fruits to that family.

In fig. 10, the longitudinal ridges are more prominent than in those specimens hitherto described, and the fruit is acuminate at its apex. It a good deal resembles certain species of walnut, disengaged from the epicarp. But the fossil fruit has no hard endocarp. It does not in this respect resemble the Juglandites rostrata, of which I have a specimen from the brown coal of Germany.

In fig. 11 the longitudinal ridges are very prominent, and a little oblique to the axis. I think it distinct from the other species that have been described. But as I have found only one or two specimens, I am not very confident.

Fig. 12 represents a very distinct species of a triquetrous form. Some of the specimens a good deal resemble the Brazil nut, (*Bertholletia excelsa*,) others have the form rather of a large beech nut, (*Fagus ferruginea*.) Fruit dehiscent at the apex, with two, and probably three valves. Outside rough and somewhat ridged lengthwise. I have but a few specimens, it being one of the rarest species, and have not been able to satisfy myself as to its internal structure.

Fig. 13 may be a smaller species of the same genus, as it is somewhat three-sided. But it is more deeply striated, and the largest side, shown in the drawing, is nearly flat. A very rare variety.

Fig. 14 exhibits an elongated fruit, slightly striated longitudinally, and having an epicarp of considerable thickness. A thin endocarp is contained within; but the seed has disappeared, and frequently, as a consequence, the fruit is compressed, and appears as if two-lobed. This is not an uncommon species. I have perhaps a hundred specimens.

Fig. 15 is probably only a smaller specimen of the last, having a form nearly spherical. It is rare.

Figs. 16, 17, and 18 are undoubtedly leguminous seeds; though I am not sure in respect to the first, which is somewhat uneven on the outside, and the base, or point of attachment, is a circle. But the other two resemble peas, or small beans, and the hilum is very manifest. They are perfectly smooth on the out-

side, and as I have found only one or two specimens, I have not examined the inside. I have never seen anything like a pod.

Fig. 19 is an exceedingly beautiful seed, with a hard though thin and frail shell, elegantly striated longitudinally, by waving lines, and corresponding ridges, too fine to be represented on the drawing. This is jet black; but on breaking through it, we find a soft light-colored lining membrane, which evidently once enclosed the kernel. But that has disappeared. The point of attachment is not at either extremity, but near one of them, extending a third of the length of the seed, as shown upon the drawing. It is not an uncommon species, though apt to be overlooked from its minuteness. I have probably obtained thirty specimens.

20.

Fig. 20 shows a piece of the coal, near the right side of which a specimen of fig. 14 is imbedded, and towards the other end, a buff-colored wrinkled integument, (*b*) resembling, save in color, a raisin, and evidently once forming the envelop of a pulpy fruit. It is still quite elastic, and less changed than any of the rest of the fruits. But no signs of what it once contained remain.

The above descriptions, I am aware, are quite meagre and defective. Probably a sagacious botanist, skilled in fossils, would detect more species among my specimens. Some of them resemble a good deal drawings of the fossil fruit and seeds of the London clay, as figured by Mr. Bowerbank, in the first number of his work on that subject. But I have thought it unwise, without seeing his specimens, to institute any comparisons. General considerations make it very probable, that fossil fruits from Vermont, will differ specifically and even generically from those of Europe, even of the same geological period.

The only other fossil fruits that I have known to be found in our country, are a few from the tertiary strata at Richmond, Va. In respect to these, Prof. Jeffries Wyman has kindly furnished me with the following description:

"In my examinations at Richmond I have frequently found lignite, and occasionally fruits; but as I was more anxious for bones, I gave them but little attention. I have identified a species of Carya, (walnut) which was so pronounced by Mr. Teschemacher, Prof. Agassiz, and Dr. Gray. I have also found one species of pine cone, in company with pine lignite. The latter was interesting, as having changed, while lying on my table, from the condition of rotten wood, soft enough to yield to the tip of the finger, into lignite of the usual hardness and having the coal-like fracture. This, however, is no uncommon occurrence, and

is said to be well known to geologists. The piece of wood just referred to, had been bored by the Teredo.

"The above are the only instances about which I would speak with any confidence. I have, also, from the same locality, a large mass of fossil resin. The vegetable fossils there found, with the teeth of Phyllodus, Cetacea, reptiles, sharks, &c., show a close resemblance of the Richmond formations to the London clay. I have in preparation a short notice in which the animal fossils of the two are to be compared."

CONCLUSIONS.

Although the specific character of the Brandon fossils are thus imperfectly known, the facts detailed will warrant several inferences of importance in American geology.

I. *The Brandon deposit belongs to a tertiary formation.* The following are the proofs:

1. It lies below the drift, and for the most part, is not consolidated. Its position as to the drift is seen at the openings made near the carbonaceous deposit; and the degree of induration,—or rather in general the want of induration,—corresponds to that of most tertiary deposits.

2. It contains all the important varieties of rock found in tertiary deposits. We have here white and variegated clays—water-worn beds of sand and gravel, beds of carbonaceous matter not bituminous, and deposits of iron and manganese.

II. *The carbonaceous matter in this deposit is strikingly analogous to that of the brown coal formation in Europe.*

1. The lignite has the deep brown color and coal-like fracture of the brown coal deposits that have not been affected by the proximity of igneous rocks, as is the case at Meisner in Hesse. Yet the woody texture usually remains distinct.

2. While this coal is distinguished from peat by burning with a bright flame, it does not give off a bituminous odor, and thus it differs from bituminous coal.

3. The degree of carbonization of the fruits, corresponds to that in the brown coal formation, as a comparison of specimens shows.

4. The sand and clays, associated with the brown coal of the Rhine valley, occur also at Brandon.

III. *The fruits and lignite of this deposit, appear to have been transported by water, and probably the accumulation took place in an ancient estuary.*

1. No example has occurred in which these fruits have been found in clusters, or attached to the branches on which they grew, or to their envelops. Nor have I found more than a single imperfect example of a leaf.

2. The lignite is in broken and usually bruised masses, as if battered by contact with one another when floating down stream.

3. The numerous places in other parts of the United States where an analogous deposit occurs,—as will be shown below,—render it probable that this was formed in an ocean, rather than a lake.

IV. *The Brandon deposit is the type of a tertiary formation hitherto unrecognized as such, extending from Canada to Alabama.*

This formation is identified by the following characters:

1. The most prominent and well known substance in this formation, on account of its economical importance, is brown hematite. In the geological surveys of Vermont, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, and North and South Carolina, this ore is described by Adams, Shepard, Percival, Mather, Henry D. and William B. Rogers, Olmsted, and Tuomey. Throughout this whole distance of 1200 miles, there is a striking resemblance in the character of the ore. It is compact, fibrous, and stalactitical; and much of it is in a state of ochre.

2. It is always more or less enveloped in clay of various colors.

3. It is almost invariably found lying upon, or near, a certain sort of limestone, or its associated and interstratified mica slate. This limestone is usually highly crystalline, and when disintegrated, it shows a large proportion of iron in its composition; and the general opinion of the geologists above named, is, that the iron originated from it. Indeed, Prof. Adams, in his first report on the Vermont Survey, has described a true vein of iron ochre in the limestone, which I have also examined. I have likewise some reason to suppose that Foss's bed of hematite in Dover, N. Y., may once have constituted a bed in mica slate.

In all the northern states, the beds of this ore occur along the western base of high mountains. And from the description of the gentleman above named, I understand this to be the case in the middle and southern states. Prof. Henry D. Rogers imputes this fact to the southern direction of the currents in the great ocean by whose waters the iron and the clay were deposited, and to the greater depression of the valley on its southeastern side. Prof. Rogers is the only geologist, I believe, who speaks decidedly of the deposition of this ore from the ocean. By this supposition he comes so near representing this formation as tertiary, that it would have needed only a bed of carbonaceous matter, such as occurs at Brandon, to have brought him upon that ground. Not improbably, now that the Brandon bed is known, similar ones may be found associated with the ore at other localities: for how long has it remained unnoticed at Brandon!

Thus does the discovery of the Brandon brown coal deposit enable us to add to American geology a tertiary formation nearly 1200 miles long, which may appropriately be placed upon our maps.

V. *This deposit probably belongs to the Pliocene, or Newer Tertiary.*

1. So far as we know, it lies immediately beneath the drift.

2. It is destitute of any consolidated beds, save the nodules of hematite; which is not true of any of our miocene or eocene deposits.

3. The brown coal of continental Europe, to which ours corresponds closely in appearance, belongs to the newer tertiary.

I confess that these arguments are not sufficient to remove all doubts from my mind as to the part of the tertiary group to which this formation should be referred. All geologists, however, I think, will say that it has marked peculiarities, which distinguish it from all the tertiary deposits of our country hitherto described; and we may at least say, that the presumption is strongly in favor of its being pliocene. It is rather remarkable if it was an oceanic deposit, that no marine remains have been found in it. I believe, however, that this is very much the case in Germany; though, unfortunately, the papers of Horner, Von Dechan, and others, on the brown coal are not within my reach.

Art. XVII.—*On a New Kind of Electro-magnet;* by M. Jerome Nicklès.

In the beautiful researches on magnetism of MM. Lenz and Jacobi, these authors have admitted that the magnetism developed in an electro-magnet does not depend on the length of the arms, but that this power is subordinate to the number of turns of the spiral which compose the helix.*

The valuable report published by Professor Muller of Friburg, on the progress of physics, contains some new facts in support of this opinion. M. Muller deduces from his experiments the following conclusions: "Other things being equal, the length of the arms of an electro-magnet is without influence on the weight raised."†

M. Dub has arrived at a different opinion, from recent experiments,‡ which have satisfied him that, under like circumstances, the attraction of an electro-magnet increases with the length of the arms. My own experiments confirm the results obtained by M. Dub, and they are the more satisfactory confirmation, since they were made with a different arrangement and before the later researches of M. Dub were published.

I have pursued for this purpose two different methods, the details of which I will give in a future communication. One is

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* Poggendorff's Annalen, lx, p. 464.
† Berichte über die Fortschritte der Physik, 1850, p. 521.
‡ Poggendorff's Annalen, lxxx, p. 49.

founded on the well known process of oscillation, the other on contact attraction. This latter method I will briefly explain.

I made the experiment more to satisfy my own mind than to verify the influence which the length of the arms of an electro-magnet exercises on the weight sustained: for it always seemed to me that the fact of this influence was evident *a priori;* because by increasing the length of a bar magnet we widen the distance between the opposite poles and diminish the neutralizing effect which these poles exert between themselves.

Yet as the contrary opinion has been sustained by the authorities above cited, I could not give as much weight to this reasoning as I should have done had it been experimentally proved. The fact in question is however put beyond doubt by my researches, and without giving full details, I can demonstrate it by a simple trial, easily repeated even as a common lecture-room experiment. I take a bar of iron surrounded by a helix of copper wire, which I place in the galvanic circuit; I select for an armature a piece of iron whose mass and length, variable according to the current, are such that the armature may be attracted without resting suspended: at this moment I place on the superior pole of the electro-magnet a cylinder of iron and immediately the armature suspends itself to the magnet and adheres there more or less energetically, to fall back when the added cylinder is withdrawn.

This experiment has been varied in many ways and has always given the results above stated. This addition of a cylinder to a bar magnet obviously lengthens it a corresponding quantity, and removes farther off the opposite pole, whose disturbing action is thus weakened.

Suppose a bar sufficiently long provided with a helix at one of its extremities; bend this into the form of a horse-shoe, we have a species of electro-magnet of which one pole only is covered with wire, and which will not less exert a more considreable attractive force when its two poles act at the same time on an armature; and this effect will evidently be obtained without the necessity of augmenting the electric current.

But if, for illustration, we suppose a straight electro-magnet slit in the line of the axis for a sufficient distance, and then if each part of the divided portion be bent back parallel with the other portion, this last, the middle portion, being the pole wound with wire, we have an electro-magnet, (see figures, next page) like a double horse-shoe magnet, with a single pole wound (m), and two outer arms (n) which are naked: and when these two are made to act simultaneously on an armature, a more powerful attraction is observed than if the wire employed had been divided between these arms.

The idea of such an electro-magnet was suggested by the necessity of conveniently protecting the helices against action from

without, and my reasoning with reference to it was dictated to some extent by an observation which will be the subject of a future communication. As the experiments are not finished, I will make but a few remarks.

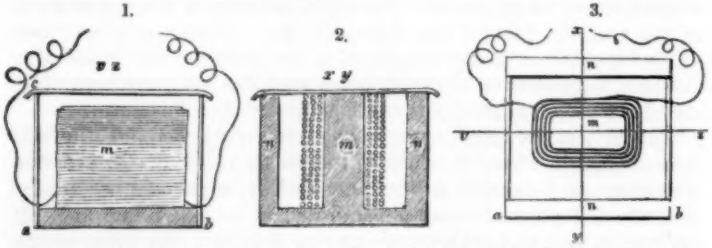


Fig. 1, a section from v to z (see fig. 3); fig. 2, a section from x to y; fig. 3, an upper view.

I have for some time tried to increase the adhesion of the motor wheels of locomotive engines by the aid of electro-magnetism, and have made a preliminary trial in connection with M. Amberger, a mechanic. The apparatus used consisted essentially of a helix lodged in a spool of brass and made to surround the motor wheel on the side where it touched the rail; the wheel could turn in the helix freely and without touching it. We found that when a strong current was passed, we could give the wheel at the point of contact sufficient magnetism to increase its adhesion.

A trial on a large scale has been made by me on the railroad from Paris to Lyons with a locomotive of 28 tons weight, drawing a train of about 100 tons, on a grade of ten millimetres inclination. An official report given to the minister of the public works, states that in this first trial we obtained through the magnetism about nine per cent. of additional adhesion. The attraction in a state of rest was 650 kilogrammes per wheel, or 1300 kilogrammes for a pair of wheels.

It is apparent, that when such a force is concentrated on a tangential point, the magnetized surface must be of considerable extent. In fact, the magnetic radiation was very perceptible at a distance of more than eight metres, and at two metres the apparatus would easily cause two bars of iron weighing 500 grammes to adhere.

This radiation, which proceeds partly from the magnet and partly from the helix, embarasses the results, producing especially a loss of force, and I have sought to get rid of it. I will say on another occasion how this difficulty is removed for the special case of wheels; I here only state that I have in the presence of this radiation conducted the experiments before mentioned; and that I have conceived the idea of taking three plates of iron united perpendicularly to a fourth plate, and of placing the wire only on the central arm, in the manner explained.

The following are the dimensions of this electro-magnet, (see figures.)

		Millimetres.		Inches.
Height *a* to *c*	=	0·08	=	3·144
Length *a* to *b*	=	0·10	=	3·937
Thickness of *n*	=	0·011	=	0·432
" " *m*	=	0·023	=	·903
Length " *m*	=	0·067	=	2·633
" " *n*	=	0·098	=	3·851

It is clear that by putting plates of iron on the two free sides and fixing over the polar surface a plate of steel so as to inclose the whole, the copper wire would be as completely protected as possible against every species of accident. The electro-magnet may be exposed to all kinds of danger without fear of injury, and in this state may be used as a brake on railroads to stop the speed or motion of the cars.

When the poles of this magnet are examined separately, it is found that the central pole only has attractive force, the two other arms having but little power; moreover, their polarity is evidently the opposite of that of the central pole; but on placing an armature over the latter, we observe at once that the two outer arms have become very powerful, conformably to the fact stated before with reference to straight electro-magnets. It is the same, if in place of putting the armature on the central pole, it be put on one of the outer arms, and, as I have remarked, it is thus with all electro-magnets, straight, curved or circular. In general, increasing the strength of one pole, is adding to the strength of the other, and the reverse.

Art. XVIII.—*On the Permeability of Metals to Mercury;* by M. J. Nicklès.*

In an interesting memoir on the permeability of metals to mercury, by Prof. Horsford, this author establishes the fact of the permeability of tin, lead, gold, silver, zinc, and cadmium, and contests that of copper and brass.

The negative results which this chemist has obtained with copper and brass, have evidently proceeded from the process which he has followed; for, some time since while engaged in my researches on magnetization, I observed positive facts to the contrary. I was using at this time a Bunsen's battery, with zinc exterior. The connecting pieces of copper were riveted to the zinc; and on amalgamating the latter metal, it often happened that the mercury spread itself over the copper in contact with the zinc: and after a certain time, the metal

* Communicated by the author in French for this Journal.

of the connecting pieces became brittle, and had on breaking, a white color. It was obviously no longer copper, but an amalgam of this metal.

This fact had too important a bearing on the amalgamation of zinc, which occupied me at that time, to be allowed to pass without examination. The experiments which I made on this subject, led to the general conclusion, that the metals which absorb mercury are permeable by it, and communicate this property to the alloys which contain a certain proportion of permeable metal. The metals on which I have operated are zinc, iron, cadmium, tin, copper, lead, antimony, silver, gold, and platinum. The manner of experimenting was suggested by the fact which had led to the researches. With a stylet I traced a line or furrow on the plate under experiment, and placed a little mercury in this furrow. In order to hasten the amalgamation, I introduced, before the mercury, a drop of bichlorid of mercury, acidified with hydrochloric acid. By this means, the amalgamation takes place instantly, and the surface is fitted to retain at once the quantity of mercury necessary for the effect I would produce.

A plate of zinc, a millimeter thick, is immediately attacked, and at the end of a minute, it is cut in two in the direction of the furrow. A thicker plate requires more time, and a deeper scratch on its surface; with a thickness of six millimeters, the plate took ten minutes and a little effort to break it: but in all cases the fracture was neat, and in the direction of the scratch or furrow.

After zinc comes cadmium and tin, then lead, silver, gold, and finally copper. All of these metals become amalgamated: the mercury infiltrates after a time more or less long, and renders them brittle. No permeability has been detected in iron, antimony and platinum, and these metals make no amalgam. Daniell has found a bar of platinum free from mercury, that had been for six years in contact with it; and to this time no amalgam of iron has been reported.

There exists, it is true, an amalgam of antimony, but, according to Wallerius, when this amalgam, of a pasty consistence, is triturated in the air, or when agitated with water, it loses its antimony in the form of a black powder.*

As to the action of mercury on metals, this fact at least is established:—the resistance of some to amalgamation, and the easy amalgamation of others. We have also shown that the permeability takes the same direction; and we may conclude therefore that the alloys will participate in these qualities in the order of their composition. In fact, a plate of bronze, five millimeters

* I should recall, in this connection, that mercury also is reduced to a black powder by agitation in the air.

thick, may be cut in two by mercury, after ten minutes of contact, and a plate half a millimeter thick, yields instantaneously. On amalgamating a strip of brass, it may, after a few minutes, be reduced to fragments between the thumb and finger. A plate of four millimeters required ten minutes to cut it in two. An alloy, formed of equal parts of antimony and tin, did not appear to be impressed by the mercury. Chaudet's alloy (3 or 4 per cent. of antimony, and 96 to 97 of tin) very elastic in its pure state, amalgamates instantly, and is easily cut off.

It is here seen that if the permeability of brass and copper for mercury is not established by the process, based on *capillarity*, followed by Prof. Horsford, we may still make this property evident by an inverse course, that is, by inducing *infiltration*.

As these experiments were made only incidentally, and were not intended to be published, I have not attempted to give them precision. Nevertheless, the facts which have been mentioned above are well established; for I have been accustomed to use this process for dividing plates of zinc or sheets of brass, in my experiments on electro-magnetism.

SCIENTIFIC INTELLIGENCE.

I. Correspondence.

Correspondence of M. J. Nicklès, dated Paris, September, 1852.

There was but little done at the Academy of Sciences during the month of August. Vacancies occurred; and the academic chairs vacated were filled by the election of several illustrious foreigners, among whom are MM. Mitscherlich, Gustaf and Heinrich Rose, and Plücker.

There have been read before the Society, this month, two memoirs on General Physics,—one of them on molecular physics, the other on the relation of specific heat to atoms.

Researches in Molecular Physics.—The principal fact of interest in the first, is a new case of isomerism, which its author, M. Pasteur, has discovered, and which facts previously known could not have suggested. This able chemist of Strasburg, arrived at this result when pursuing his researches on the relations which exist between crystalline form, chemical composition, and rotatory molecular phenomena, and has thus thrown new light on the mechanical department of chemical combinations.

M. Pasteur had previously established the principle that the direction of the rotatory molecular action of solutions depended on the hemihedrism of the crystals, that rotation to the right implied a right-handed hemihedrism, and to the left, left-handed. Further, that one and the same substance may furnish examples of both of these characters, or in other words, that two substances, one right- and the other left-handed, may differ only in crystallographic and rotatory peculiarities, being in every other respect identical.

His first researches had been made on crystals of tartaric and racemic acids. Each of these acids presents both kinds of hemihedrism, under the same crystallographic planes, one being the reverse of the other. But the two acids, the right- and the left-handed, afforded by racemic acid retain their peculiar hemihedral and rotatory properties in their compounds when the bases present are without action on polarized light; the two series of salts are identical except in the hemihedrism and the rotatory phenomena.

But he has now made the new discovery, that if, in place of combining these acids with bases inactive to polarized light, they are united with substances that affect the plane of polarization in some way, all identity ceases. The corresponding compounds have no longer the same composition, nor the same solubility; neither do they act in the same way when exposed to a high heat. Often the combination is possible with a right-handed substance, and impossible with the left-handed. Thus the right-handed bitartrate of ammonia combines equivalent to equivalent with the ordinary bimalate of ammonia, which is active in polarization; but the left-handed bitartrate enters into no combination with this bimalate.

M. Pasteur cites a large number of examples of this kind, and explains in a simple manner these important phenomena. When the two tartaric acids, the right and the left, combine each with an optically inactive substance, such as potassa, the inactive substance modifies in the same manner the rotatory power of both compounds. The two acids were identical though not superposable optically, and this is still true of the two compounds. But when the two acids are united to an active base, as cinchonine, there is in one case an *addition* to the rotatory power, and in the other a *subtraction*.

M. Pasteur considers it probable that all right-handed substances may have a corresponding left-handed condition, and reciprocally. He also believes that every active substance may have an inactive correspondent. He further announces that he can easily communicate the rotatory power to a large number of organic products, and that he has succeeded in transforming cinchonine and quinine into new isomerous bases which are inactive to polarized light.

On the relation of Specific Heat to Atoms.—The law of Dulong and Petit has been extended through the researches of M. Garnier, who has determined the relation that exists between the specific heat of water and that of a simple body on one hand, and between the atomic weight of water and that of the same body, on the other.

If we divide the atomic weight of water 112·5 ($H^2=12{\cdot}5$ and $O=100$) by 3, the number of the elementary atoms, we have $112{\cdot}5 \div 3 = 37{\cdot}5$, a number which may be called the elementary atomic weight of water. On comparing this mean atomic weight with the atomic weight of simple bodies, we find a curious relation between this weight and the specific heats. Thus the atomic weight of copper is 395, consequently, (as $395 \div 37{\cdot}5 = 10{\cdot}5$,) this number is 10·5 times greater than the mean atomic weight of water. The specific heat of copper is 0·0951, that of water being 1, and hence dividing the latter by the former ($1{\cdot}0000 \div 0{\cdot}0951 = 10{\cdot}5$), we ascertain that the specific heat of water is 10·5 times greater than that of copper, or precisely in an inverse ratio to its mean atomic weight.

If, as is not improbable, the same relation subsists between water and other simple bodies, we may calculate directly the specific heats of the simple bodies from the atomic weights. It is only necessary to divide the mean atomic weight of water, 37·5, by the atomic weight of the simple body and reduce the fraction obtained to decimals.

M. Garnier has presented his results in tables. He feels assured, that what in this relation is true of water is equally true of other compound bodies.

These results call to mind a relation brought out by M. Hankel,* between the crystalline form of metallic iron (tesseral system) and oxyd of antimony (tesseral) on one side, and peroxyd of iron (rhombohedral) and metallic antimony (rhombohedral) on the other—an alternate relation like the preceding, having a resemblance to the above in this respect, and which on no other ground has admitted of generalization.

Double Refraction artificially produced in Crystals of the tesseral or regular system.—A memoir on this subject by M. Wertheim, has afforded a generalization of a fact observed long since by Biot, namely, that substances not possessing double refraction may acquire it from pressure.

This author, engaged in the vaults of the Conservatory of Arts and Measures, continues with perseverance his researches on the modifications which matter may undergo under the influence of torsion, traction and compression. I have seen at his rooms, plates of fusible, untempered steel, twisted in every direction, which retained perfectly the form which the torsion had given it, contrary to the opinion of some authors (Lagerhjelm and others) with regard to the elasticity of this metal.

Lightning.—Communications to the Academy on cases of lightning are quite frequent, owing especially to the impulse given to the study of these phenomena by M. Arago. The observations made during the storms of the present summer (1852), have placed beyond doubt the important fact respecting "globular lightning," that it differs from ordinary lightning in several points, especially in the slowness of its movement, less brilliancy, and also by its apparent indifference to metallic conductors, which ordinary lightning follows with great readiness. This kind of lightning, first distinguished by M. Arago, from facts on record, comprises a variety of meteoric phenomena known under the name of thunder balls, thunder globes of fire, globular lightning, fulminating globes, ("Tonnerre en boule," "tonnerre en globe de feu," "foudre globulaire," "globe fulminant,") and according to Babinet, it often accompanies strokes of ordinary lightning.

It is desirable that the kind of *lightning conductor* suggested by M. Arago, should be constructed, which discharges clouds of circumscribed thunder storms by means of anchored balloons, and so prevents the disastrous effects of these storms, as has already been done by M. de Romas, Dr. Lining of Charleston, and Mr. Charles, with kites provided with conducting cords. Since according to Franklin's observations, lightning rods are more effective the greater their height, we may by means of balloons obtain currents of electricity which possibly may be

* Poggendorff's Annalen.

of use in agriculture and industrial operations. Who does not remember the long sheets of light which Franklin and M. de Romas succeeded in drawing close beside them from their kites. Since electricity is effective in ozonizing oxygen and converting it into *electrized* oxygen, (as it is designated by MM. Becquerel and Frémy,) so increasing the action of its affinities, we may believe that the fertilizing influence of the rain of storms may be due to the oxygen of the atmosphere they electrize, rather than to the nitric acid, or the nitrate of ammonia found in the waters. Without denying the influence of these azotized substances, we know that ozone is produced on such occasions in torrents, and plays a principal part.

I will give in another place, a description of the apparatus used by MM. Becquerel and Frémy, in their experiments on electrized oxygen, and which with a single element of Bunsen's battery afforded in a vacuum a continuous spark several centimetres in length.

Butyric Alcohol.—Among the chemical facts brought forward at the Academy the past month, we notice the discovery of butyric alcohol by M. Adolph Wurtz. This alcohol, $(C_8H_9)O, HO$, which has been detected by M. Wurtz in the caput mortuum of the oil of potatoes, so much studied by chemists, furnishes a new verification of the beautiful theory of alcohols of Dumas, in which several lacunes have been recently filled by the cerotine and melissine of Mr. Brodie, and by the caprylic alcohol which M. Bouis has derived from castor oil.

Researches in Analysis.—Two memoirs bearing on the subject of analysis, of very opposite character, have been presented to the Academy. One by H. Sainte Claire Deville, "on new general processes in chemical analysis," complicates this branch of science with a series of precautions and processes quite appalling to the practical man or the amateur chemist. M. Deville uses only reagents that are volatile, in such a way that the proof of their purity, under certain relations, can be obtained exclusively with a plate of platinum. The memoir does not say how to determine sulphuric acid, phosphoric acid and numerous other bodies. And while waiting for the author to explain himself on these points, we may believe that the present condition of analytical chemistry is not so bad that the method of Deville has much to change in its processes.

The other memoir is by MM. Fordos and Gélis. Its object is to simplify, and that very much, so as to render accessible to those little experienced, a determination which has been undertaken hitherto only by professional chemists. We refer especially to the analysis of cyanid of potassium, so much used at the present time in the galvanoplastic art and in photography, and which is always impure and of variable composition, rarely containing more than 50 p. c. of the real cyanid.

MM. Fordos and Gélis—well known for their fine memoirs on the acids of sulphur, and who besides have produced the double hyposulphite of gold and soda, so important in photography—have applied to the examination of the cyanid of potassium the process which had succeeded with them so well in the analysis of the sulphur acids, and which consists in using a normal liquid of iodine. The reaction is very simple, as follows:

$$Cy\,K + 2I = IK + I\,Cy.$$

The memoir gives the details of manipulation, and provides for the adulterations to which the cyanid of potassium is liable.

Besides the researches which have been presented to the Academy of Sciences, which will soon be known in America, if not already, there are others either unpublished or little known, which merit at least a mention of their titles to engage for them the attention of the scientific public.

Of this number, one is the apparatus of Ruhmkorff, already mentioned, by means of which, *dynamical electricity is transformed into static electricity*. Another is,

A new Process for determining Dilatations, by M. J. F. Silbermann, the director, as learned as he is modest, of the National Conservatory of Arts and Measures. This process was employed for the first time in the comparison of the standard meter which formed a part of the collection of weights and measures sent to the United States by the French Republic in exchange for the collection of weights and measures from the government of the United States.

The processes hitherto used give the dilatations only to a sixteenth of a millimeter, which degree of precision had been considered very satisfactory. But M. Silbermann has exceeded this limit, carrying the precision even to the one-hundredth of a millimeter. The feature in this process consists essentially in employing a new method for tracing an invariable length on the rules used in investigating the dilatation between 0° and 100° C. To arrive at this invariable length, M. Silbermann uses a beam compass with very solid points held in a wooden trough full of melting ice. This compass is made of a steel rule $1^{m}{\cdot}20$ long, 5 centimeters wide and about 8 millimeters thick: it carries two very solid points, attached at a distance of a meter apart. The points are of tempered steel and their extremities are turned and sharpened with great care. The trough for receiving the compass is triangular, "l'une de ses arêtes tournée vers le bas;" and there are two openings through which the points of the compass pass.

Whilst the compass is in the melting ice, the rule which is under trial is also put in, and this last is kept in for at least two hours. After this time has elapsed, the beam compass is placed on the rule, and after the pointing is done, the latter is taken from the melting ice. The rule is then put in boiling water for two hours, preparatory for the second pointing. The difference of dilatation is then determined by means of a simple combination of lenses, the arrangement of which cannot be well explained without figures.

M. Silbermann has had the kindness to go through this process in my presence; and it will give some idea of its simplicity when I say, that I afterwards repeated the process with little trouble and very satisfactory results.

This same process has also been used to determine the co-efficient of dilatation for a meter of platinum, sent by the French government to the Great Exhibition at London.

The absolute dilatation of the meter of annealed steel, sent to the United States was found to be 1·0502 millimeters, between the temperatures of 0° and 100° C. Compared with the standard of platinum, deposited at the Conservatory of Arts and Measures, the annealed steel

meter was found to be 0·0266 millimeters too short, so that the legal value of this standard meter is 0·9999774 meters, whilst the brass meter, also sent to the United States, has the value 1·0002992 meter at 0°. Its coëfficient of dilatation was determined by Gambey. In another communication we will give a figure of Silbermann's apparatus.

Ruhmkorff's Apparatus for transforming Dynamical into Statical Electricity.—The construction of the apparatus is based on the fact demonstrated in 1841, by MM. Masson and Breguet, that the fluid developed by induction in a helix surrounded by another traversed by a galvanic current, by turns interrupted and re-established, is statical electricity. The principle is thus applied by Ruhmkorff.*

S, is a helix formed of 8000 spiral turns of a copper wire one-third of a millimeter in diameter. This helix contains within it another formed of 300 turns of coarser copper wire, two millimeters in diameter, whose extremities end in the two small columns A A; the extremities of the wire of the other helix pass through a clamp in the columns B B. The wires of the two helices are perfectly insulated, and the outer borders, C C, of the latter, terminate in two plates of glass secured by the pieces D D. At the centre of the two helices, a cylindrical bundle of iron wire is placed, in order to augment the intensity of the current of induction by the magnetization which it undergoes while the current is passing.

The pile used with this apparatus communicates with the clamps E E through conductors; from E the current passes to the break-piece F, which takes it to the coarse-wire helix (the inner); the direction in which the current is to pass is regulated by means of the button M, which is fastened at the axis of the commutator or break-piece. The interruption of the principal current is made by means of a mechanical arrangement like that which we describe below, which was first proposed by De la Rive and afterwards improved by M. Miraud. In the apparatus of M. Ruhmkorff, this kind of break-piece consists of a hammer, fixed to a shank which rests on the support O, and which can turn on a hinge so that it may rise and fall. The superior surface of its extremity is terminated by a piece of soft iron covered with a thin plate of platinum; against the bundle of iron wire above this same extremity and opposite to it, there is another surface covered also with platinum which acts as an anvil. When the core of iron wire is magnetized by the passage of the current, it draws the hammer to it; but as the hammer on rising breaks the circuit, the principal current ceases, the core loses its magnetism, the hammer no longer attracted falls by its weight; then the current being re-established, the hammer is again raised, and so on. By these alternations, rapidly made, a current of induction is produced in the helix with fine wire (the outer). To facilitate the magnetization and demagnetization of the hammer and regulate the number of interruptions, a plate of soft iron, P, is placed on a small table in front of the core of iron wire and below one of the columns A, which may be moved up or off at will.

* We retain the particulars of the description as written out by M. Nicklès; but owing to indistinctness in some parts of the drawing, we are compelled to omit the figure.

To experiment with this elegant little machine, the conductors for receiving the electricity developed are fastened in the clamps B B; if these conductors communicate with the outer and inner surfaces of a Leyden jar, they charge it as well as if the jar were put in connection with an ordinary electrical machine. If we connect with this apparatus the two balls of an electric egg, a series of sparks is produced, forming a true flame, passing from the negative to the positive pole, which demonstrates once more the curious fact discovered by M. Neef, that electric light appears always at the negative pole of the pile. The fact is much more marked when a vacuum is made; as the air leaves the egg, the light becomes more distinct, and when the vacuum approaches its maximum, there is a true luminous arc more than a decimeter in length.

M. Sinsteden, who has paid much attention to subjects of this kind, has arrived at similar results. It was he who suggested the most important peculiarity of this apparatus,* which is, the complete isolation of the two helices, a result accomplished by enveloping each in two tubes formed of leaves of tin, separated from one another by silk and shell-lac. These tubes become thus true condensors, giving electricity of tension, as if in communication with an electrical machine. As to the rest, Mr. Henry and M. Riess have a long time since made observations of a similar character.†

This machine may also give shocks. By fastening in the clamps B B, the extremities of the conductors which end in the handles, and taking hold of the handles with the hands, there is a shock which may be made insupportable. A burning sensation is felt on touching one of the clamps with the finger.

In connection with the facts which have been stated, it is important to mention a singular observation made by M. Ruhmkorff, which he reported to me more than a year since, and which M. Sinsteden has also since brought out.‡ It has been seen that the hammer and anvil are covered with platinum foil. But if silver-leaf be substituted, no sensible sign of static electricity is observed, and hardly any sensation is felt on touching the conductors with the tongue. M. Sinsteden attributes this singular effect to the greater conductility of silver and consequently its less resistance. This does not appear to us admissible, for M. Ruhmkorff has observed that copper, which is nearly as good a conductor as silver, affords nearly the same effects as platinum.

The following is a brief description of

De la Rive's Interruptor as improved by Miraud.—An electromagnet A, (fig. 2) is placed horizontally or vertically on a flat surface, and is put in connection on one side with one of the poles of a galvanic pile, and on the other with a flexible spring, G H, which carries at C a plate of soft iron. This spring rests against another spring

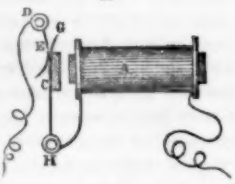
* Poggendorff's Annalen, lxxxv, 492.

† [The name of Dr. C. G. Page should here be added. There are many points of similarity between the apparatus of M. Ruhmkorff and the compound electromagnet and electrotome of Dr. Page, whose apparatus appears to be but little known in Europe. See this Journal, vol. xxxv, 252, 1839.—Eds.]

‡ Poggendorff's Annalen, May, 1852, 482.

D E, which is put in communication with the other pole of the pile. When the spring C H touches the spring D E, the current is closed and the plate C is attracted at once by the electro-magnet: this interrupts the current and the spring C H springs back to the spring D E; when the current passes anew and there is another attraction, and so on. The vibrations produced by this arrangement are so rapid that it produces a sound like the buzzing of a fly.* This apparatus has been applied to electro-medical purposes, in which it is a convenient substitute for toothed wheels.

2.



Correspondence of T. S. Hunt of Montreal, on Atomic Volume.

As to atomic volume I have a new suggestion. In the gaseous state, volumes and equivalents are identical, and an idea of this kind, as true to a certain extent of bodies in the solid form, lies at the basis of the calculations of Kopp and yourself; but while in some cases the volume appears identical, in others it varies widely. Now in vapors we should, from a want of such conformity, have argued that the equivalent was not rightly fixed, and this you know is readily determined otherwise in most organic volatile bodies; while in minerals we have arbitrarily assumed the simplest ratio of the constituents, as expressing the equivalent, and shaped our atomic volume to this. Now I suppose that all bodies in the same crystalline form have the same atomic volume, and hence from this we may calculate their true equivalents; hence their relative equivalent being the same, the density is the index of their complexity, or in other words indicates, (pardon the truism,) their degree of condensation. To begin by fixing an equivalent,—*Alum* (in the regular system,) is $\dot{A}l\,\bar{S}_3$, $\dot{K}\,\bar{S}$, $24\dot{H}$ and with an equivalent of 474·6 (H=1) and sp. gr. 1·75 has a volume of 271. Chrome alum is 268·6. The mean is about 270. Compared with this, *magnetite* is not (FeO, Fe_2O_3) with a volume of 22·7, but $12FeO, 12Fe_2O_3 = (Fe_{12}fe_{36}, O_{48})$ with a volume of $22{\cdot}7 \times 12 = 272{\cdot}4$, and so on. Rhombohedral and octahedral specular iron have about the same sp. gr., and if we assume their volume to be the same, we have a transition to another system without change of volume; we have for *Corundum*, 15·5 $Al_4O_4 = (Al_{62}O_{62})$ with a volume of 268·5, and homologue of $(M_{48}O_{48})$ or magnetite. So *Polybasite*, in which copper in a double equivalent Cu, enters, (as I have been able to prove,) *is accurately represented by* $8(Ag, Cu)S + (Sb, As)S_4 = M_8Sb, S_{12}$: but its sp. gr. corresponds to $(M_{16}Sb_2S_{24})$ with a volume of 270. Quartz (silica being SiO) is $Si_{25}O_{25}$, at. vol. 267. [Mr. Hunt proposes to present his views in detail in our next number.—J. D. D.]

* [This apparatus is very nearly identical with the *vibrating armature* break-piece of Dr. Page and Daniel Davis, for more than ten years in use in all forms of electro-medical apparatus. The American contrivance has the additional convenience of an easy adjustment for the rapidity of its vibrations, offering every facility in the graduation of shocks.—Eds.]

II. Chemistry and Physics.

1. *Stibmethylium and its Compounds.*—Landolt has communicated a second memoir on the compounds of antimony with methyl, which may be considered as ammonia or ammonium in which nitrogen is replaced by antimony and hydrogen by the radical methyl, C_2H_3. The iodid of stibmethylium $Sb\,Me_4I$, which forms the starting point of this investigation, is obtained by bringing stibmethyl, $Sb\,Me_3$, into contact with iodid of methyl, when the two soon unite to form the iodid as a white crystalline mass, easily purified by crystallization. If this iodid be distilled with antimoniuret of potassium in a vessel filled with carbonic acid gas, an oily liquid, heavier than water and igniting in the air passes over, which the author considers as the isolated radical stibmethylium $Sb\,Me_4$. Stibmethylium forms with one equivalent sulphur, chlorine, bromine, iodine or oxygen, compounds which possess the strongest analogy to those of potassium and ammonium. The oxyd is a powerful base intermediate in its properties between potash and ammonia and forming with acids both neutral and acid salts which appear to be isomorphous with the corresponding potash and ammonia compounds. These salts possess uniformly a bitter taste and with the exception of the sulphid are without smell. Potash and soda are the only bases which precipitate the oxyd of stibmethylium from its compounds. The presence of antimony is not indicated by reagents until the compound is completely destroyed. The salts of stibmethylium may be heated to 100° or 140° C. without change, unless the action of heat is long continued: heated to 180°–200° they begin to fume and then take fire and burn with a voluminous white flame. The compounds of stibmethylium exert no poisonous action on the animal economy; the author swallowed two grains dissolved in water without experiencing any ill effects. The oxyd of stibmethylium is prepared by treating a solution of the iodid with oxyd of silver, quickly filtering the liquid, and evaporating over sulphuric acid under the air-pump, when a white crystalline mass remains which is doubtless the hydrated oxyd. This substance behaves in all respects like caustic potash, is excessively caustic, gives when rubbed between the fingers the slippery feeling of the alkali, and attracts water and carbonic acid from the air. The carbonate effervesces strongly with acids. The solution of the oxyd expels ammonia from its salts and precipitates almost all metallic oxyds like potash.

The sulphid of stibmethylium is prepared like the sulphid of potassium and is an amorphous greenish powder of a strong odor of mercaptan, and soluble in water and alcohol. The formula is $Sb\,Me_4S$. The iodid of stibmethylium crystallizes in the hexagonal system and forms beautiful 6-sided tabular crystals. [It is therefore not isomorphous with iodid of potassium.—W. G.] The chlorid of the new radical crystallizes also in the hexagonal system, and the properties both of this salt and of the bromid resemble those of the iodid. With chlorid of platinum the chlorid of stibmethylium forms a beautiful orange-yellow crystalline powder represented by the formula, $Sb\,Me_4Cl + Pt\,Cl_2$. The sulphate of stibmethylium forms large colorless crystals which

appear to belong to the right-rhombic system, and which have the formula, $Sb\,Me_4O,\,SO_3+5$ aq.; it is readily soluble both in water and alcohol. The author did not succeed in forming an alum with the sulphate of alumina. The bisulphate of stibmethylium forms beautiful hard colorless crystals which have the formula $Sb\,Me_4O.SO_3+HO.SO_3$. The author describes further a nitrate, carbonate, bicarbonate, oxalate, and acid tartrate, but gives no measurements by which to justify his statement that the compounds of stibmethylium appear to be isomorphous with those of potassium and ammonium.—*Journal für praktische Chemie*, lvii, 129.

2. *Note on the Kakodyl of Valerianic Acid.*—As the compounds of metals with organic radicals are becoming every day of more importance to the theoretic chemist, I am induced to mention in this place the results of some experiments made in November, 1849, on the formation of new organic compounds containing arsenic. When valerianate of potash is distilled with an equal weight of arsenous acid, a heavy oily liquid passes over into the receiver, slightly yellowish in color, and possessing a penetrating and highly offensive odor of garlic. With a solution of chlorid of mercury this liquid gives a thick white precipitate, while the odor of garlic disappears and is replaced by an agreeable aroma, like that of valerianate of oxyd of amyl. The oily liquid gave off thick white vapors in the air but did not inflame. Exposed for some time to the air in an imperfectly closed glass vessel it became completely converted into a mass of large brilliant hard four-sided prisms, which were nearly colorless, and after pressing with bibulous paper, free from smell. They had an acid reaction and may have been the valerianic compound corresponding to kakodylic acid. These crystals were readily soluble in water. In an attempt to unite them with oxyd of silver for the purpose of determining their constitution they were completely decomposed. The oily liquid obtained by the distillation above mentioned was soluble in water and appeared to reduce oxyd of mercury to the metallic state. It will be seen that the reactions of the substance in question in all respects resemble those of the butyric kakodyl obtained by Wöhler, and exhibit much analogy to those of the acetic kakodyl of Bunsen. The offensiveness of these compounds to non-chemical noses belonging to persons occupied in the same building with the writer, have hitherto prevented a further investigation of this subject, which it is to be hoped will engage the attention of chemists more advantageously situated.—W. G.

3. *Constitution of Spermaceti.*—Heintz has published in detail the results of his investigation of this subject—results which differ in many particulars from those obtained by other chemists. Spermaceti was saponified by boiling with an alcoholic solution of caustic potash. The solution was precipitated by chlorid of barium, and the baryta salts thus obtained freed from ethal by washing with alcohol which at the same time dissolved a portion of a baryta salt soluble in alcohol but insoluble in ether. The etherial solution also yielded a third baryta salt. Heintz studied separately an alcoholic solution from which the last named baryta salt was finally separated, the expressed ethal, and the three baryta salts. The ethal was found to possess the constitution assigned to it by Dumas, viz., $C_{32}H_{33}O+HO$. The alcoholic solution

from which the third baryta salt was separated, yielded a substance fusing at 10°–12° and having the formula $C_{18}H_{18}O_2$, which may possibly be the aldehyd of pelargonic acid. The fatty acids in combination with baryta were separated from each other by the method of partial precipitations employed by Heintz with so much success in his examination of human fat. In this manner five homologous acids were separated, viz., the cocinic, myristic, cetic, palmitic, and margaric acids, which exist in spermaceti in the form of salts of the oxyd of cetyl. Heintz terms these salts, cocäthal, myristäthal, cetäthal, palmäthal and margäthal. Their formulas are

Margäthal or margarate of cetyl,	$C_{32}H_{33}O+C_{34}H_{33}O_3$
Palmäthal or palmitate of cetyl,	$C_{32}H_{33}O+C_{32}H_{31}O_3$
Cetäthal or cetate of cetyl,	$C_{32}H_{33}O+C_{30}H_{29}O_3$
Myristäthal or myristate of cetyl,	$C_{32}H_{33}O+C_{28}H_{29}O_3$
Cocäthal or cocinate of cetyl,	$C_{32}H_{33}O+C_{26}H_{25}O_3$

Besides these compounds, however, spermaceti contains probably a small quantity of olein which is doubtless derived from the oil from which the spermaceti has crystallized. A second neutral substance was also obtained in small quantity: it was soluble in ether but only with great difficulty so in alcohol; its formula appeared to be $C_{28}H_{26}O_4$. —*Journal für praktische Chemie*, lvii, 30.

4. *Positive Photographic Pictures.*—Adolphe Martin has given a method of producing directly positive pictures upon glass, which appears to possess great advantages. Two grammes of cotton are to be converted into gun-cotton by a mixture of 50 gr. of nitrate of potash and 100 gr. of sulphuric acid: the product is to be well washed, dried, and dissolved in a mixture of alcohol and ether so that the solution shall contain for 1 gr. gun-cotton, 120 gr. ether, and 60 gr. alcohol. To this solution is to be added a mixture of alcohol and iodid of silver obtained by dissolving 1 gr. of nitrate of silver in alcohol and precipitating the solution with iodid of ammonium. The glass plate prepared in the usual manner and covered with a thin layer of this solution is to be dipped before drying into a bath composed of 1 part distilled water, $\frac{1}{12}$ of nitrate of silver and $\frac{1}{10}$ of nitric acid, and then exposed a few seconds in the camera. It is then to be dipped into a bath of sulphate of iron, and afterward carefully washed. The picture is now negative, but if it be dipped into a bath of the double cyanid of silver and potassium it becomes positive. It is to be washed, covered with a varnish of dextrin, dried, and framed upon a background of black velvet. The cyanid bath is that of Elkington and Ruolz, diluted with 3 vols. of water; it consists of 1 litre of water, 25 gr. of cyanid of potassium, and 4 gr. of nitrate of silver.—*Comptes Rendus*, xxxv, 29.

5. *Determination of arsenic in cases of poisoning.*—Van Kerckhoff has examined Schneider's method of determining arsenic by the volatilization of the chlorid—already described in this Journal, (xiv, 259)—and has found by quantitative experiments that a portion of the arsenic remains behind in the retort, so that the process can at best be but a qualitative one, and even from this point of view is inferior to that already in use.—*Journal für praktische Chemie*, lvi, 395.

6. *Cocinon, Myriston and Lauro-stearon.*—DELFFS has prepared and analyzed cocinon, and Overbeck, myriston and lauro-stearon. Cocinon, as prepared by the distillation of cocinate of lime, crystallizes in light, brilliant white scales; it is tasteless and without smell, is soluble in ether and alcohol, fuses at 58° C., and solidifies to a crystalline spermaceti-like mass. Its formula is $C_{42}H_{42}O_2$ or $C_{21}H_{21}O$. Myriston and lauro-stearon crystallize in brilliant white scales, and solidify on cooling after fusion in crystalline masses, which become highly electric by friction. Myriston has the formula $C_{50}H_{50}O_2$ or $C_{25}H_{25}O$, and fuses at 75° C. Lauro-stearon has the formula $C_{46}H_{46}O_2$ or $C_{23}H_{23}O$, and fuses at 66° C.—*Pogg. Ann.*, lxxxvi, 587, 591. W. G.

7. *On the Allotropic Modification of Oxyd of Cobalt;* by F. A. GENTH of Philadelphia, (communicated for this Journal by Dr. GENTH.) —One of my students, Mr. Edwin L. Reakirt, has discovered the allotropic modification of oxyd of cobalt, corresponding in all its properties with the allotropic modification of oxyd of nickel, which I detected several years ago.* It was obtained accidentally by the decomposition of the carmine chlorid of my cobalt bases, (Fremy's chlorhydrate de roseocobaltiaque,) by heat, and after dissolving out the chlorid of cobalt, it remained pure. It occurs in iron black, very brilliant microscopic octahedra, with a submetallic lustre. They are not magnetic. They are insoluble in hydrochloric or nitric acid, but readily dissolve by fusion with bisulphate of potash. The quantity obtained was too small for further examinations; but judging from analogy, there is no doubt as to its composition. It contains no nickel. By the decomposition of the above mentioned salt, I have often obtained metallic cobalt, but never before this oxyd. I will mention here, that I have several times observed the allotropic modification of oxyd of nickel, in quantities not exceeding 0·5 or 1·0 in the metallic nickel manufactured in Hesse-Cassel and imported to this country.

8. *Observations on the Zodiacal Light made at the Kew Observatory from January to April*, 1850; by Mr. H. R. BIRT, (Proc. Brit. Assoc., 1852, Ath., No. 1298.)—These observations were made at the Observatory of the British Association during the author's residence there. It appeared to the author that two very important features presented themselves in connection with the observations:—viz., the *position* of the great mass of light being constantly *north* of the ecliptic,—and, the apparent change in the *form* of the light, or at least that portion of it forming the apex of the luminous triangle on the cone of light, which is very perceptible in the groups of observations, those in February presenting a narrower cone, the axis being very perceptibly *inclined* to the ecliptic. In this respect these observations are in decided contrast with those of March, when the cone of light had become much larger, the apex more rounded, and the inclination of the axis to the ecliptic changed. It would appear from the projections that accompanied the observations, that while the great mass of light was still northward of the ecliptic the direction of the axis was so inclined that it occupied a *different* position with respect to the ecliptic than it did in February.

* Ann. der Chem. und Pharm., 53, p. 139.

In the month of April the author considered the axis of the zodiacal light to be slightly north of the ecliptic, the *northern* side of the cone still exhibiting the greatest luminosity. The contrast of the observations in this month (April) with those in February, is very remarkable; —the cone had become very considerably enlarged, and consequently much broader than the cone seen in February. Two observations, those of March 3 and April 10, were particularized as indicating that under peculiar circumstances *we see more of the zodiacal light* than is presented to us ordinarily. In connection with these phenomena the author observed earlier in March a sudden brightening of the light for an instant, and also variations in its lustre of an intermittent character. These intermissions of brightness were observed on the same evenings by Mr. Lowe, at Nottingham. They are described by the author not to be of the nature of pulsations in the usual acceptation of the term, but to consist of alternate brightenings and dimmings of the entire mass of light such as might be produced by the approach and recess of a luminous body.

9. *On the Form of Images produced by Lenses and Mirrors of different sizes;* by Sir David Brewster, (Proc. Brit. Assoc., 1852, Ath., No. 1298.)—The object was, to show that the photographic portraits taken with cameras with large object-glasses or large mirrors must necessarily be distorted and hideous, as in fact it is notorious they are; and that hence all persons engaged in this new and most important art should receive with gratitude any scientific discovery which promised to correct so serious a defect—which by some has been attributed to the imperfection of the lenses employed,—by others to the unsteadiness of the sitter who is having his portrait taken,—by others, again, to the constraint of features and limb under which he submits to the operation; but it is by all admitted and deplored. If we consider that the pupil of the human eye is only about $\frac{2}{10}$ths of an inch in diameter, it is obvious that the images formed by the eye of those solid objects placed in front of it, and by which we are accustomed to see them, to judge of them, and to recognize them, cannot embrace any of the rays of light which come from those parts of the object which lie in such positions towards the sides, top, bottom or hinder parts as cannot pass in straight lines to an aperture of the size of the pupil,—in fact, unless it agree almost exactly with the exact perspective form of the object, the pupil being the point of sight. If then an object be placed before a lens, the part of the lens towards its centre, of the size of the pupil, is capable of forming a correct image of that object, consisting of rays coming from precisely the same parts of it as an eye would receive were its pupil in the same position. But all the parts of the lens or mirror of the same size which lie around and at a distance from this portion of it, would receive rays coming from parts of the solid object which the true eye could not receive, and which must therefore form as many unnatural images as there were such parts; and the photographic picture which embraces and confounds into one hideous mass all these, any one of which by itself would be correct, must in the very nature of things give a most confused and displeasing representation of the object. Sir David illustrated and proved these assertions by a diagram of a lens with a simple solid form, a cylinder topped by a cone behind,

placed in front of the lens, pointing out the parts which alone could be embraced in a correct perspective view of it, and what parts the large lens or mirror would moreover receive and transmit rays from, to be jumbled in the photographic picture with that which would alone give a correct idea of the object as seen. He showed from the now familiar illustration afforded by the binocular stereoscope, how very dissimilar were the pictures of the same object received by small lenses placed as near as the two pupils of the human eye; images so distinct that a child could readily distinguish them; and yet multitudes of such images were all received and jumbled together in those photographic pictures where lenses or mirrors of that or larger—say three or four inches—aperture were used. "The photographer, therefore," said Sir David Brewster, "who has a genuine interest in the perfection of his art will, by accelerating the photographic processes with the aid of more sensitive materials, be able to make use of lenses of very small aperture, and thus place his art in a higher position than that which it has yet attained. The photographer, on the contrary, whose interests bribe him to forswear even the truths of science, will continue to deform the youth and beauty that may in ignorance repair to his studio, adding scowls and wrinkles to the noble forms of manhood, and giving to a fresh and vigorous age the aspects of departing or departed life." He then produced an exact diagram of photographic images of a simple object produced by Mr. Buckle of Peterborough, whose Talbotypes obtained a Council Medal at the Great Exhibition. The acting diameter of the lens was $3\frac{1}{8}$ inches; and by using it with all covered, except a central space of $\frac{2}{10}$ths of an inch diameter, and then along with this space exposing circular spaces of the same size towards the outer circumference of the aperture, the effect of the combination of the marginal pictures was most distinctly exhibited and demonstrated, by halos extending round the true image, and the sharp cross lines ruled on the object and shown in the image with the small lens, but all confused in that with the surrounding apertures.

10. *On a Rock-Crystal Lens and Decomposed Glass found in Nineveh;* by Sir David Brewster, (Proc. Brit. Assoc., Athenæum, No. 1298.)—Sir David said that he had to bring before the Section an object of so incredible a nature that only the strongest evidence could render the statement at all probable:—it was no less than the finding of a rock-crystal lens, in the treasure-house at Nineveh, where it had for centuries lain entombed in the ruins of that once magnificent city. It was found in company with several bronzes and other objects of value. He had examined the lens with the greatest care and taken its several measurements. It was not entirely circular in its aperture, being $1\frac{6}{10}$ths inches in its longer diameter and $1\frac{4}{10}$ths inches in its shorter. Its general form was that of a plano-concave lens, the plane side having been formed of one of the original faces of the six-sided crystal of quartz, as he had ascertained by its action on polarized light,—this was badly polished and scratched. The convex face of the lens had not been ground in a dish-shaped tool in the manner in which lenses are now formed, but was shaped on a lapidary's wheel, or in some such manner. Hence it was unequally thick, but its extreme thickness was $\frac{2}{10}$ths of an inch, its focal length being $4\frac{1}{2}$ inches.

It had twelve remains of cavities which had originally contained liquids or condensed gases; but ten of those had been opened probably in the rough handling which it received in the act of being ground; most of them therefore had discharged their gaseous contents. Sir David concluded by assigning reasons why this could not be looked on as an ornament, but as a true optical lens.

Sir David then exhibited specimens of the decomposed glass found in the same ruins. The surface of this was covered with iridescent spots more brilliant in their colors than Peacock copper ore. Sir David stated that he had several years since explained how this process of decomposition proceeded, on the occasion of having found a piece of decomposed glass at St. Leonard's. It had contained manganese, which had separated from the silex of the glass, at central spots around which circles of most minute crystals of true quartz had arranged themselves; bounded by irregular jagged circles of manganese, these being arranged in several concentric rings. When this process reached a certain depth in the glass it spread off laterally, dividing the glass into very thin layers, and new centres seemed to form at certain distances, and thus the process extended.

11. *On Magnetism and Diamagnetism;* by Prof. MATTEUCCI, (Proc. Brit. Assoc., Ath., No. 1299.)—The author examined the influence of high temperatures and of compression on several substances. Iron, when passing from ordinary temperatures to a fusing heat, under the action of the oxyhydrogen blowpipe suspended by cocoon silk by a piece of caustic lime or a horizontal bar of copper wire in the magnetic field of a powerful electro-magnet, suffered a diminution, in one sufficiently exact experiment, of at least fifteen million times. All the compounds of iron and all natural substances containing a portion of metallic iron suffer a diminution by heat. Hence it is that all the natural and artificial compounds of magnetic and diamagnetic substances, such as certain coals and charcoal, impure metals, gold, copper, zinc, &c., which are attracted at ordinary temperatures, appear to be temporarily repelled when strongly heated. The repulsive action of diamagnetic substances suffers a very slight diminution by fusion. But this is not the case with bismuth, with respect to which the author had verified and completed the observation of Plücker. The Professor then detailed experiments proving this. He had also examined the influence of violent mechanical compression on magnetic and diamagnetic substances:—for instance, by means of a copper box furnished with a screw, he compressed a cylinder of bismuth 3 millimeters diameter and 34 millimeters long to 28 millimeters, and found it had when compressed a diamagnetic action distinctly superior to that of its natural state. He had confirmed the fact discovered by Coulomb, and more recently by Plücker, that the oscillation of bismuth and of other feebly magnetic substances was independent of their weight,—or, in other words, that the diamagnetic power is proportionate to the weight of the cylinder. He had also examined the influence of powerful electro-magnets on chemical affinity and on cohesion, and given several detailed results. He has studied the influence of the magnetic power of the elements on that of the body resulting from their combinations. Although some elements which are diamagnetic have magnetic compounds, such as the protc-

chlorate of copper, he found that in general the magnetical character of the compound results from that of its elements. He has made a number of experiments on the laws of equilibrium of diamagnetic bodies in the magnetic field, and on the reciprocal action of diamagnetic bodies; the methods of observing used being simple and ingenious, chiefly by observing the change of form or the curve of the common surface of one fluid when floating on another. He passed over many other topics with brief notice; and concluded with calling Prof. Faraday's attention to what he believes to be the most important fact of these researches, and which relates to an experimental theory of diamagnetic phenomena. We abstain from publishing a full abstract, as the author wishes himself to arrange these researches before publication.

12. *On a Manifold Binocular Camera;* by A. CLAUDET, (Proc. Brit. Assoc., Ath., No. 1299.)—The author exhibited a Double Camera for taking the two stereoscopic daguerreotypes of groups or individuals,—and by which four double pictures could be successively taken with such rapidity as to be exact representations of the same circumstances. It would be impossible to make all the mechanical arrangements of this instrument intelligible without drawings. The author also exhibited an instrument, which he called a stereoscopometer; by which he could accurately measure the angles, by which could be determined the place of the group or figure to be taken, and the position in every one of their adjustments of the double camera and its slides.

13. *On Poisson's Theoretic Anticipation of Magno-crystallic Action;* by Dr. TYNDALL, (Proc. Brit. Assoc., Ath., No. 1299.)—In an article in the *Phil. Mag.* for March, 1851, Prof. W. Thomson had drawn attention to the fact that Poisson had theoretically anticipated the discovery of magno-crystallic action by Plücker; and, in the latest number of the "Annual Report of Liebig and Kopp," Dr. Tyndall's investigations are referred to as especially corroborating the above view. Highly as he prized the support and coincidence of Prof. Thomson on a scientific subject, he must decline subscribing to his views in the present instance; and he thought he would prove that the theory of Poisson was unsuited to explain the phenomena of magno-crystallic action. By means of a powerful electro-magnet, Dr. Tyndall had been enabled to prove each of his statements by actual experiment. Poisson supposed a magnetic body to be an assemblage of magnetic molecules, and in the case of certain crystalline bodies, he imagined that these molecules possessed an ellipsoidal shape. Supposing such a body to be magnetized in a certain direction, and all these ellipsoids to lie with their longer axes in the same direction, the attraction of such a body parallel to these longer axes would be different from its attraction in a transverse direction. A differential action, such as that here indicated, was certainly established by the experiments of Prof. Faraday and Dr. Tyndall; but its cause is not to be referred to the shape of the molecules, as supposed by Poisson. A crystal of calcareous spar was hung in the magnetic field, and its action exhibited,—its optic axis set equatorial. A model of white wax of the same shape and size as the spar, and at first sight almost to be mistaken for a crystal, was hung in the magnetic field, and exhibited a precisely similar action—its axis was also set equatorial. A crystal of carbonate of iron was next examined,—its axis set from pole to pole; a magnetic model of the crystal did the same. Dr.

Tyndall then proceeded to show that a bar of magnetic or of diamagnetic matter might be caused to set axal or equatorial, by simply varying its point of suspension. The experiments were closely watched by Prof. Thomson, who certified the success of every one of them. "Now," proceeded Dr. Tyndall "we have here two substances, exactly alike in exterior shape,—one a crystal built by nature, the other a model constructed by myself; you have seen that the actions of both are identical,—the one is not to be distinguished from the other. Whatever explains the deportment of the model must explain that of the crystal also. This piece of wax is composed of material particles; now I ask, what must the effect be if I squeeze this wax between two plates? will it not be to bring the particles more closely together along the line on which the pressure is exerted? This is simply what has been done in the case of the model, and this peculiar arrangement of its particles (without reference to their *shape*) produces the effects which you have witnessed. Now, the action of the model comes under the head of magno-crystallic phenomena, and we see that the theory of Poisson is totally inadequate to its explanation. Magno-crystallic action is thus proved to be due, not to the shape of the ultimate molecules, but to their manner of arrangement."

14. *Examination of Dove's Theory of Lustre;* by Sir DAVID BREWSTER, (Proc. Brit. Assoc., Ath., No. 1300.)—The author explained the theory of Dove, which, if we took him correctly, was, that the lustre of bodies and particularly the metallic lustre arose from the light coming from the one stratum of the superficial particles of bodies interfering on the eye with the light coming from other and deeper strata,—the regular symmetrical arrangement of the particles in these bodies producing effects somewhat analogous to that of mother-of-pearl. But the opinion which Sir David himself seemed to incline to, was, that since we know from the phenomena of very thin metallic leaves that lights of very different colors are transmitted through strata of different kinds of matter and of different thicknesses, and since from the different refrangibility of lights of these colors, the same lens will not bring them to a focus at the same distance,—metallic lustre was caused by the effort used to accommodate the eye to the distinct vision of these colors. He illustrated this by the effects produced when the two figures of a binocular stereoscope were colored with complementary colors, and viewed together in the instrument.

15. *Notice of a Tree struck by Lightning in Clandeboye Park;* by Sir DAVID BREWSTER, (Proc. Brit. Assoc., Ath., No. 1300.)—The tree stood in a thick mass of wood, and was not the tallest of the group. The lightning bolt struck it laterally about 15 feet above the ground, exactly at the cleft where the two principal branches rose from the trunk. A large part of the bark and a piece of the solid wood were driven to some distance, and the electric fluid passed down the trunk into the ground, splitting the tree in two by a rent through the whole of its thickness. The fact contained in this notice, that an object may be struck by lightning in a locality where there are numerous conducting points more elevated than itself, shows that a lightning bolt cannot be diverted from its course by conductors, and that the protection of buildings from this species of meteor can only be effected by conductors stretching out in all directions.

III. Geology.

1. *On the Connection between Geological Theories and the Figure of the Earth;* by Mr. H. Hennessey, (Proc. Brit. Assoc., Ath., No. 1299.)—As Geology may be considered to embrace an examination of the form and structure of the earth, it follows that every correct geological theory must be capable of explaining the greater as well as the lesser inequalities in the figure of our planet. Certain geological theories being incompatible with the supposition that the earth was originally in a state of fluidity, attempts have been made to account for its spheroidal figure by the abrading action of the waters at its surface. It has been shown by Playfair and Sir John Herschel that the earth would from such causes ultimately tend to assume the form of an oblate spheroid; but neither of these eminent mathematicians has presented such numerical results as would enable us satisfactorily to compare the theory with observation. This the author has effected in a paper communicated to the Royal Irish Academy, in which he deduces for the polar compression according to the theory in question $\frac{1}{1\,0\,1\,4}$. The compression given by measurements is $\frac{1}{3\,0\,0}$; consequently, it seems that the theory of the earth's primitive solidity must be rejected in favor of that of its primitive fluidity, which agrees with observation. The author also pointed out an inconsistency in the theory of climates proposed by Sir Charles Lyell in order to account for the diminution of temperature at the earth's surface since early geological epochs. This theory would require a gradual transport of matter from the equator to the poles, in order to account for a diminution of the heating surface of dry land at the equator. Consequently, on this theory, the earth would tend to become prolate instead of oblate. The author concluded by pointing out similar objections to the geological views known as the Neptunian theory and the chemical theory of volcanoes.

2. *Geology and Palæontology of a part of the Rocky Mountain Region;* by Prof. J. Hall, (from Capt Stansbury's Expedition to the Great Salt Lake, p. 401.)—This report is made out from the specimens collected by Capt. Stansbury and the notes taken in the course of his expedition. We insert here some extracts.*

"The first specimens furnished are from the west side of the Missouri River, near and above Fort Leavenworth, (39° 21′ N., 94° 44′ W.) These are all from limestone of the *carboniferous* period, and apparently from the upper of the two great limestones of this period in the west. The most conspicuous fossils are *Productus*, *Terebratula*, &c.

The route from the Missouri westward shows a continuation of this limestone as far as the Big Blue river, (40° N., 96° 40′ W.)

Here it disappears, judging from specimens and remarks in the notes. It is soon succeeded by strata of *cretaceous* age, which, from the speci-

* The route of Capt. Stansbury was from Fort Leavenworth on the Missouri, in 39° 21′ N., 94° 44′ W., up the Missouri and Platte to Fort Kearney, in 40° 39′ N., 98° 58′ W.; up the North Fork of the Platte to Fort Laramie, in 42° 12½′ N., 104° 31½′ W.; still west on the same Fork, leaving it for the tributary called the Sweet Water in 42½° N., 107° 10′ W., and thence to the southward and westward through the South Pass to the south side of the Salt Lake where (in 40° 46′ N., 112° 6′ W.,) the Mormon city is situated.

mens preserved, I have been able to recognize as extending for a considerable distance on the route between Turkey Creek and Big Sandy.

Among the cretaceous fossils are a species of *Pholadomya*, and the *Inoceramus*, which is so abundant in numerous localities in this region.

It is quite probable that these beds extend much farther, but I find no specimens in the collection; and the notes indicate that there are heavy deposits of drift, which may have covered the formation below." * *

"It would appear that the character of the country from near Fort Kearny to near Fort Laramie is uniform, and that no deposits of older date than the tertiary were observed. Of the specimens collected there is but a single individual indicating the character of a marine formation. From the condition of the bones it may even be questioned whether the deposit containing them is not of post-tertiary age.

The specimens from the vicinity of Fort Laramie are all from limestone of the *carboniferous* period. Some of the fossils are identical with species collected between the Missouri and the Big Blue, and we can only suppose, from the great similarity of the specimens, that it is a continuation of the same formation. From the dates marked upon the specimens, it is evident that this limestone extends to some distance on the east and west of Fort Laramie.

The specimens bearing date of July 19th, two days' march northwest of Fort Laramie, (105° W.,) are a feldspathic granite with little quartz or mica. The rocks in this locality are doubtless of metamorphic origin, probably rocks of Silurian age. The specimens collected three days' march in advance of this place, (105° 25′ W.,) are shaly sandstone and thinly laminated sandstones containing fossils. The fossils are some brachiopods, with others similar to *Monotis*, and we may presume from the described position of the beds, and from the character of the fossils, that these beds are of Devonian age. In the journal these beds are recorded as dipping at the rate of 15° to the northeast.

The specimens bearing the mark of July 24th, (105° 50′ W.,) are precisely like those collected at Fort Laramie, and contain the same species of fossils. On the same date were seen (according to the journal) gray and red sandstones. On the following day (near 106° W.,) is recorded a bed of coal, three or four feet thick, with *Sigillaria* and *Calamites*. The specimens of this date sent to me are those of bituminous coal and others of soft shale, but without any well-marked vegetable remains.

From the proximity of limestone of the age of the coal, and the record of Sigillaria and Calamites occurring in the same connection, it may be presumed that this coal belongs to the true coal measures; and this locality is probably an exposure indicating the existence of a great basin. This point itself and the surrounding country are well worthy of a more extended examination, since the discovery of workable beds of coal in this region would be a matter of national importance.

The record of July 27th (106° 45′ W.,) shows the occurrence of red shales and sandstones, which may be of the age of the coal, or beneath that formation." * * * "From the Wind River Mountain to Ft. Bridger (in 41° 18′ N., 110° 32′ W.,) the collections are all of *marine tertiary*, including many specimens of *nautilus* and others of marine shells." "West of Fort Hall (43° N., 112½° W.,) are chert and limestone of carboniferous age."

"The specimens collected in the islands and shores of the Great Salt Lake are sufficient to give one a very good idea of the general geological features. The specimens are of metamorphic rocks, consisting of talcose and mica slates, hornblende rocks, and a few specimens of granitic or syenitic character.

Some specimens of the latter description occur along the valley of Ogden's River. Antelope Island, Frémont Island, a part of Promontory Point, and Mud Island, on the east side of the lake, judging from the numerous specimens, consist principally of talcose and mica slates, with hornblende rock. Carrington Island, Hat Island, a point north by west from Hat Island, name not known, and a part of Strong's Knob, consist of similar rocks with some of altered sandstone or quartz rock. In several localities, as at Promontory Point and near Mud Island, the metamorphic strata appear to be overlaid by a coarse conglomerate, or coarse sandstone, which is partially altered, and assumes the character of a quartz rock.

From all the facts in my possession, it would appear that these metamorphic rocks are distinctly stratified and highly inclined, but do not attain any great elevation. The direction of the ranges, corresponding to that of the elevating forces, appears nearly to conform to north by west and south by east. From the form of the lake and the different localities at which rocks of this character occur, we may infer that there were two lines of elevation, corresponding with the divisions of the lake.

The more elevated portions of the lake shore, and the mountain ranges, consist of carboniferous limestone. In some localities this limestone is partially altered, losing its granular character and becoming sub-crystalline, or threaded by numerous veins of calcareous spar. In most localities, however, the limestone abounds with fossils, particularly corals of the Cyathophillidæ." * * *

"Although I have not felt at liberty to color on the map any other points than those indicated both by the notes and by specimens examined, yet I can have no doubt that all the elevated ranges on the west, south, and north of the Great Salt Lake are capped by the carboniferous limestone. Judging from the relative position of the limestone, and the metamorphic rocks of Antelope and Frémont's Islands, the former occupies the position of low, synclinal basins, the valleys between being produced to a large extent probably by erosion along the anticlinal axes, occasioned by the elevation of the metamorphic beds. We may expect, also, that the same limestone will be found upon the elevated plateaus and mountains on the east side of the lake.

It will be seen from these facts that we have very satisfactory information that this *limestone of the carboniferous period* is widely distributed in the region around the Great Salt Lake. Its position relative to the coal-bed on the North Fork of Platte River has not been determined; but since no beds of coal have been observed on the slopes of the mountains in the region of the Salt Lake, we are left to infer that the coal is to be sought (as elsewhere) above the limestone. Since the existence of coal is proved in one point, (admitting the evidence in favor of its age being that of the carboniferous period,) we are warranted in the conclusion that it once existed over a much wider area, and can be sought with success in the proper situations. The impor-

tance of this mineral in that distant region cannot be too highly estimated, and the geographical position and extent of the beds should be one of the first points ascertained in the location of any route of communication between the east and the west."

The Report contains also descriptions and figures of various fossils, mostly from the carboniferous rocks, being species of several corals, Brachiopoda, (one species of Terebratula, three of Productus, three of Spirifer, one of Chonetes, one of Orthis,) a few acephala, besides a Pleurotomaria and a Euomphalus, in all 14 new species. One species is the *Chonetes variolata* of Koninck.

3. *Geological Survey of Canada:* Report of Progress for the year 1851–2; by W. E. Logan, Provincial Geologist. Printed by order of the Legislative Assembly. 121 pp., 8vo. Quebec, 1852—In our last volume we gave a notice of some of the important results of Mr. Logan's survey. The Report here issued dwells mostly on the discoveries of economical value. He states that the whole amount of gold for the season, (about five months) obtained in the Chaudiere region on the R. de Loup, was 1900 pennyweights. *Phosphate of lime* in nodules is disseminated in rocks of the lower Silurian age at several localities. The amount of phosphoric acid present was ascertained by Mr. T. S. Hunt, chemist to the Survey, (p. 105 of the Report) who found in some of them—

	I. R. Ouelle. Sandstone.	II. R. Ouelle. Conglomerate.	III. Lac des Allumettes. Sandstone.	IV. Glenville. Sandstone.
$\dot{C}a^3\ \ddot{P}$,	67·53	40·34	36·38	44·70
$\dot{C}a\ \ddot{C}$,	4·35	5·14*	5·00*	6·60
$\dot{M}g\ \ddot{C}$,	1·65	9·70	7·02 (diff.)	4·76
$\dot{F}e$,	2·95	$\dot{F}e$, 12·62†		$\dot{F}e$, 8·60‡
Insol. sand,	21·10	25·44	49·90	27·90
Vol. matter, $\dot{H}$,	2·15	2·13	1·70	5·00
	99·73	95·37	100·00	97·56

The nodules are of various shapes, sometimes as observed by Mr. Hunt at the river Ouelle in hollow cylinders (I), sometimes in nodules or globular masses more or less flattened, (II, III,) at times appearing compact, like worn fragments of slate (IV). Mr. Hunt suggests that they are remains of bones or coprolites, though with hesitation, as this implies the existence of Vertebrata during the Lower Silurian epoch. Other information in this report we defer to another number.

IV. Botany and Zoology.

1. *Carices Americæ Septentrionalis exsiccatæ.* Edidit H. P. Sartwell, M.D. Pars 1-2. Penn Yan, Nov. Ebor. 1848–50.—These two volumes consist of actual specimens of 158 species and varieties of the genus *Carex*, finely prepared, and arranged by Dr. Sartwell with great neatness and care. The specimens are, for the most part, collected by himself, in his immediate neighborhood, where very many species are found; but Dr. Sartwell has taken the utmost pains, by cor-

* With some fluorid. † With a little $\ddot{A}l$ and a trace of $\dot{M}n$. ‡ With a trace of $\ddot{A}l$.

respondence with botanists throughout the Union, to obtain from them the species peculiar to their respective localities; and has thus been enabled to include, in his two parts, rather more than a quarter of the known species of this vast genus; of which representatives are found in almost every part of the globe.

The time and exertion requisite for such a work as this of Dr. Sartwell, can only be estimated by the practical collector, who has toiled through bog and brake, "from morn till dewy eve," loaded with his folios and collections. But the search for the various species, though arduous, constitutes only a small part of the needful labor, since the drying and preparation of specimens, so beautiful as those before us, is a matter requiring much time and care; even in the case of so practised a hand as Dr. Sartwell. No reasonable price would be a compensation for the production of such volumes, and hence they rarely appear, except when offered as labors of love, and gratuitously distributed, as in the present instance. Dr. Sartwell has, for many years past, taken an especial interest in these plants, and having observed them with an acutely discerning eye, has selected and arranged his specimens with great accuracy. Each species occupies a separate sheet, to which is appended a printed label with number, name and synonymes, place of growth, and name of collector, when derived from other hands than his own. The numerical order of the specimens is that of Dr. Gray's Manual of Botany, following which, we shall briefly remark on a few of the species.

"No. 1. *C. dioica*, L."—This is *C. gynocrates*, Wormsk., and though very closely resembling C. dioica, differs from that species in several particulars; especially by the shorter, loosely-flowered spikes, and the lanceolate, *diverging* perigynia, which are less distinctly nerved, and smooth, or very slightly serrulate on the beak. C. dioica is probably confined, on this continent, to Arctic America and the Rocky Mountains.

"No. 12. *C. Sartwellii*, Dew."—This plant, first collected in New York, by Dr. Sartwell, was dedicated to him by Professor Dewey, some years since; but it does not appear to possess any sufficient characters by which it can be distinguished from No. 71, *C. disticha*, Huds.; a very variable species, in different localities and stages of growth.

"No. 14. *C. prairea*, Dew."—If this is specifically distinct from *C. paniculata*, L, (which is very doubtful,) it will probably have to bear the prior name of *C. Ehrhartiana*, Hoppe, to which it has been referred by Dr. Boott.

"No. 21. *C. cephaloidea*, Dew.," appears to be only a stouter form of No. 22, *C. cephalophora*, Muhl.; but No. 75 (from Illinois) is, doubtless, the plant of Dewey, which is scarcely distinguishable from No. 20, *C. sparganioides*, Muhl., except from its inferior size.

"No. 29. *C. gracilis*, Ehrh."—Dr. Boott has ascertained, from an authentic specimen, that this name belongs to *C. loliacea*, L. Hence, that of Schkuhr, *C. tenella*, will attach to this species, commonly known to American botanists as *C. disperma*, Dew.

"No. 33. *C. sphærostachya*, Dew.," if distinct from *C. canescens*, L., must bear the prior name of Fries, *C. vitilis*.

"No. 40. *C. Liddoni*, Boott," is surely nothing more than a small form of No. 11, *C. siccata*, Dew. Dr. Sartwell's plant, though entirely

different from that of Boott, which is probably confined to the N. W. coast, is, however, the C. Liddoni of Dewey, (Wood's Botany,) and of the writer, (Gray's Manual of Botany.)

"No. 48. *C. straminea*, Schk.," scarcely differs from No. 77, *C. alata*, Torr. and Gr., except in the rather inferior size of the spikes. Three other varieties of C. straminea are given in No. 76.

"No. 49. *C. straminea*, Schk., *var. moniliformis*, Tuck," is *C. adusta*, Boott, a species approaching very near to No. 44; which is generally understood, though without absolute certainty, as *C. festucacea*, Schk.

No. 51, is correctly, though doubtfully, referred to *C. torta*, Boott.

"No. 53. *C. acuta*, L., *v. erecta*, Dew., *C. aperta*, Boott?" This appears to differ from Boott's plant, principally in the smaller size of the spikes, and it would be difficult to distinguish them by any intelligible characters. *C. acuta*, L. has not been found on this continent.

"No. 55. *C. strictior*, Dew.," does not seem to be specifically distinct from No. 54, *C. stricta*, Lam.; a name which must, assuredly, be continued for the American plant, since the species was originally founded, by Lamarck, on specimens from "Virginia and Pennsylvania;" whereas, the C. stricta of Goodenough, and of European botanists generally, has never been found on this continent.

"No. 57. *C. salina*, Wahl.?" is also a form of *C. stricta*, Lam., with curved and misshapen perigynia. It is referred, by Gay, to C. verrucosa, Freedl.

"No. 91. *C. Careyana*, Dew.," should have been ascribed to Dr. Torrey, in correspondence with the original description by Professor Dewey.

"No. 130. *C. Houghtonii*, Torr.?" is not Torrey's plant. It is, perhaps, a hairy-fruited form of No. 129, *C. striata*, Mx.

"No. 146. *C. lupulina*, Muhl." The name of *C. gigantea*, Rudge, is here, erroneously adduced as a synonyme. C. gigantea is distinguished, from all its immediate allies, by the *spreading* perigynia, and several (2–5) barren spikes; more nearly resembling *C. retrorsa* Schw. than C. lupulina.

It is probable that botanists may differ from Dr. Sartwell as to some forms which he regards as distinct species; but this is matter of small moment, and those who are so fortunate as to possess a set of his valuable exemplars, will have the best opportunity for study and comparison. It is, indeed, to be regretted that these beautiful specimens cannot, in the very nature of the case, be so widely diffused as might be desired, more especially among European botanists; since the difficulty of assigning arbitrary specific characters to the species of so vast and intricate a genus, leads, unavoidably, to many misapprehensions, which the generous labors of Dr. Sartwell are better calculated to correct, than the best possible verbal descriptions. J. C.

2. *J. G. Agardh, Species Genera, et Ordines Algarum.* Lund., 8vo, vol. i, 1848. Vol. ii, pars. 1, 1851; pars. 2, 1852.—The second part of the second volume of this elaborate and excellent work has appeared since the brief announcement in a former number of the Journal (vol. xiii, p. 53.) Professor Harvey's great work on the North American Algæ, published by the Smithsonian Institution, has awakened so much interest in the study of Algæ, that many of our readers may be glad to

know that the most trustworthy general treatise on the whole family, or *kingdom*, as Professor Agardh terms it, is making rapid progress towards completion. The first volume (362 pages) contains the *Fucoideæ* complete. The two parts of the second volume (720 pages) include 13 of the 16 orders, as they are called, of the *Florideæ*, or rose-red Algæ, or all except those of Agardh's series *Desmiospermeæ*, subseries *Corynospermeæ*. It was only in 1824 that the system Algarum of the older Agardh was published, which comprised characters of all the Algæ then known, both of salt and fresh water, in a single small 18mo volume, of 312 pages. A. G.

3. *L. R. Tulasne, Monographia Podostemacearum.* (Excerpt. e tom. vi, Archiv. Mus. Hist. Nat.) Paris, 1852, pp. 208, imp. 4to, with thirteen plates.—This is an admirable monograph of a remarkable able and anomalous family of aquatic Dicotyledoneous plants, most of which imitate the Sea-weeds, Liverworts and Mosses in their organs of vegetation. Our own single representatives in the United States, and from which the order takes its name, was the earliest known to botanists, having been detected in Virginia by Barrister, and by him sent to Plukenet; although many years elapsed before it was described in Michaux's Flora Boreali-Americana, under the name of *Podostemon ceratophyllum*. Meanwhile a related plant had been discovered in Guiana by Aublet, his *Mourera fluviatilis*. Two other South American species were found by Humboldt; and a number of Brazilian species, belonging to two or three new genera were discovered by Martius, St. Hilaire, and Riedel. Meanwhile Petit-Thouars had made known three new genera of the order from Madagascar. In recent times the number of known species has largely increased, chiefly through the researches of the late Dr. Gardner, in Brazil and in Ceylon, and of Mr. Weddell, in the interior of South America. Bongard reduced the known genera to three; one of which, his *Philocrena*, proves to be the same as the *Tristicha* of Thouars. Endlicher admits six genera. Tulasne has now raised the number to twenty; and has described about eighty species. They are all tropical, with three exceptions; namely *Tristicha Dregeana*, and *Sphærothylax algiformis*, of the Cape of Good Hope, and our own *Podostemon ceratophyllum*, which extends north even as far as to the tributaries of the St. Lawrence. (At least I have it from the Black River, the most eastern stream flowing into Lake Ontario, on the southern side.) About two-thirds of the whole belong to South America, east of the crest of the Andes. Tulasne gives an account, first of the anatomy and organography of the plants of this order, with full details; and then considers the question of their affinity. On this point (beyond the indisputable fact that they are dicotyledoneous plants, notwithstanding that Martius and Bongard took the opposite view) he arrives at no more definite conclusion than his predecessors; but he hazards the conjecture that they may be reduced representatives of Lindley's Geranial Alliance; just as Myriophyllum and Hippuris are reduced Onagraceæ. As to useful properties, it appears that the *Marathra* of New Grenada are greedily eaten by cattle, who seek for them in the rocky river-beds when the waters fall. On the upper waters of the Amazon certain Podostemaceæ are largely eaten by the natives, as is the *dillisk* and *sloke* in Ireland and Scotland. Mr. Spruce, in a letter

just published, (in the October number of Hooker's Journal of Botany,) briefly states that "the Podostemata that grow on the falls are a chief article of support to the natives for one half of the year." Tulasne arranges the genera according to progressive complexity, or perfection of floral structure; beginning with those that are diœcious (*Hydrostachys*,) or androgynous, and destitute of floral envelops, and ending with those that have a true perianth and perfect flowers. Yet even those of comparatively high floral organization (such as *Castlenavia*, *Devillea* and *Terniola*, perfectly imitate Hepaticeæ in their vegetation; and *Tristicha hypnoides* might readily be mistaken by a casual observer for a true Moss.) The thirteen plates, some of them colored, and all crowded with exquisite analyses, are of the very highest order, and illustrate most of the genera characterized. A. G.

4. *Seeman, Botany of the Voyage of H. M. S. Herald, &c.* Part 2, pp. 61–80, plates xiii–xx. The first part of this work already noticed, contained the botany of Western Arctic America. The present is occupied with the Flora of Panama: it comprises a brief historical notice, and a detailed introduction, giving an account of the geographical features of the country, its climate, and the general characteristics of its vegetation, with notices of the most remarkable or useful plants, those used for medicine, food, cordage, dyes, &c., being separately enumerated. It affords much interesting information respecting a country with which large numbers of our own people now have much to do. Then follows a few pages of the Flora itself, which is here carried only through some of the earlier families. We are glad to see that the plants of Fendler's Chagres collection are enumerated. A good map of the country is given, comprising the provinces of Bocas del Toro, Veraguas, Panama and Darien. A. G.

5. *Walpers, Annales Botanices Systematicæ*, tom. ii, pp. 1125, iii, fasc. 1–4, pp. 786, 8vo, 1851–52: Leipsic.—The former volume, published in 1848–9, gave the characters of all the species, as far as known to the compiler, which had appeared in the years 1846 and 1847. This goes over the same ground for the years 1848, 1849, and 1850, in systematic order, following the arrangement of DeCandolle. Nineteen hundred pages in very small type are required to give merely the characters of the species published in various works or scattered papers during three years, down as far as to the Grasses, in the midst of which the fourth fascicle of the third volume breaks off. This rapid increase shows how needful is such a compilation as the present. The work has cost great labor; and even the few who have access to full botanical libraries will be thankful for it, although the pages abound with errors of the press, and slips or less venial mistakes of the transcriber. The *Genera Am. Bor. Or. Illustrata*, vol. i, is everywhere cited, up to page 660, as *Torr. Gen. Pl. Amer. Bor.* (The second volume, although published early in 1849, does not appear to have been seen by Walpers.) On the other hand, articles or species plainly published by Dr. Engelmann, under his own name, are attributed to Dr. Gray, as, for instance, the Portulaceæ on p. 660, et. seq., and the Cacteæ on p. 680, 684, and 686. A. G.

6. *Stansbury's Expedition to the Great Salt Lake.*—We have briefly noticed this very valuable Report in volume xiv, at page 291; and on

pages 126–129 of this number have cited from Mr. Hall's Report on the Geological Specimens. The Zoological and Botanical Reports connected with the volume contribute very largely to the value of the work. The Reports on Mammals and Birds are by Prof. S. F. Baird; that on Reptiles by Prof. Baird and Charles Girard; that on Insects by Prof. S. S. Haldeman; and that on Botany by Dr. John Torrey.

The Report on Mammals includes, besides notes on the known species, Putorius vison, P. erminea, Meles labradoria, Gulo luscus, Fiber zibethicus, Spermophilus 13-lineatus, and Ovis montana, a description of the new species *Vulpes macrourus*, Baird, and *Pseudostoma castanops*, Baird. The first is from the Salt Lake Valley. It resembles the *Vulpes fulvus*, but besides other differences, its tail is six inches longer. Color of the back, a mixed grizzled gray, the hairs being dark brown at the base, then yellowish-white, and finally tipped with black. The Pseudostoma is from the Prairie road to Bent's Fort, where it was collected by Lieut. Abert. It is in size between P. borealis and P. bursarius; the color is grizzled but lighter than in the P. bursarius; and there is a strongly marked chestnut circular space about $1\frac{3}{4}$ in. in diameter on each side of the head.

The Report on Birds contains the new species *Sialia macroptera*, from the neighborhood of the Salt Lake, and the *Pipilo Alberti*, from New Mexico, and notices of many known species. A list is added containing the names of over 150 species of birds from west of the Mississippi, which are not described in Audubon's Ornithology.

Among the Reptiles, there are the following new species, the most of which are illustrated with excellent figures. We cite the brief specific descriptions.

Siredon lichenoides, Baird.—Body uniform blackish brown, covered all over with licheniform patches of grayish yellow; snout rounded; tail compressed and lanceolated; toes broad and short.

Cnemidophorus tigris, Baird and Girard.—Scales on the subguttural fold small in size; four yellowish indistinct stripes along the dorsal region.

Crotaphytus Wislizenii, Baird and Girard.—Head proportionally narrow and elongated. Cephalic plates and scales on the back very small. Yellowish brown, spotted all over with small patches of deeper brown or black.

Genus Holbrookia, Girard, (syn. Cophosaurus, Trosch.)

Holbrookia maculata, Girard.—Tail about the length of the trunk. Head subcircular, slightly conical in front. Pectoral fold bordered with large scales.

Genus Uta, Baird and Girard.—Upper part of the body covered with minute scales; a pectoral fold; auditory apertures; femoral pores, but no anal ones.

Uta Stansburiana, Baird and Girard.—Tail slender, elongated, and conical, provided with large scales arranged in verticils; a subgular fold in addition to the pectoral one.

Sceloporus graciosus, B. and G.—Head subconical; scales of the back proportionally large; tail of medium size, slender and conical

Elgaria scincicauda, B. and G.—Dusky green above; light ash color below. Eleven transverse black bands on the back, interrupted on the dorsal line; white dotted posteriorly, six or more on the tail. Thirteen to fourteen rows of scales, well carinated.

Plestiodon Skiltonianum, B. and G.—Head small, continuous with the body; tail stout, very long, and subquadrangular; olivaceous brown, with four broad bands of black.

Genus Churchillia, B. and G.—Three pairs of frontal plates; a very small loral, and several postorbitals. Scales carinated.

Churchillia bellona, B. and G.—Body yellowish, with a series of large subhexagonal patches of brown bordered with black, and two or three rows of smaller

patches on the sides. A brownish black band across the eyes, from top of head to the angle of the mouth.

Coluber mormon, B. and G.—Posterior frontal plates very large; vertical plate long and very narrow on its middle; eyes very large.

Heterodon nasicus, B. and G.—Minute and numerous frontal plates instead of two large pairs; two brown stripes over the head; temporal patch very broad.

A "monographic essay on the genus Phrynosoma," by C. Girard, next follows, beautifully illustrated, and containing the new species *P. platyrhinos*, G., *P. modestum*, G.

Prof. Haldeman's Report on Insects, contains descriptions of 25 new species, and is illustrated by two plates representing 13 species.

Dr. Torrey's Report is illustrated by nine plates, representing as many species.

7. *A New Genus and Species of Crustacea;* by JAMES EIGHTS.—This Antarctic species from the New South Shetlands, belongs to the Idotæa family. It is remarkable for its gigantic size, the length being $3\frac{1}{4}$ inches and the breadth across the middle $1\frac{3}{4}$ inches. It is also peculiar in having the 6 anterior legs short and monodactyle or ancoral, while the 8 posterior are long, stout, triangulate, spinose, and end in a short claw. Superior antennæ short, half the inferior in length, having a very short flagellum; inferior pair with a multiarticulate flagellum as long as the basal portion. Form of body oblong ovate. Abdomen 5-jointed, the last segment subtriangular with sinuato-arcuate sides, and subcarinate longitudinally along the middle above. Thorax also somewhat carinate along the middle of the back, and surface of segments sculptured: mandibles without palpi. The species is named by Dr. Eights, *Glyptonotus antarcticus*. The paper is accompanied by two handsome plates, representing a dorsal and ventral view of this fine species, and giving a separate view of the antennæ.—*Trans. Albany Inst.*

V. ASTRONOMY.

1. *New Planet;* (Astron. Jour., No. 50.)—On the 19th of September, 1852, another planet, (the *twentieth* of the Asteroidal group,) was discovered by Prof. A. de Gasparis of Naples. It resembled a star of the ninth magnitude, and its place was, Sept. 19, $10^h\cdot 20^m\cdot 24^s\cdot$ m. t. Naples, R. A. $0^h\cdot 12^m\cdot 10^s\cdot 73$, and N. Decl. $1°\ 53'\ 0''\cdot 6$. The same planet was discovered independently the next day, by M. Chacornac of Marseilles.

2. *Return of the Twin-Comet of Biela*, (Astron. Jour., No. 49.)—The comet discovered Aug. 26, 1852, by Prof. Secchi of Rome, proves to be a portion of the twin-comet of Biela on its expected return. In a letter to Dr. Petersen, dated Rome, Sept. 16, 1852, he says, "I have the pleasure of announcing to you that I found this morning the other portion of Biela's comet. It was very faint, without a nucleus, and of an elongated ovoid form, the apex being turned away from the sun. It followed the other part at a distance of about two minutes of time, and was about half a degree farther south. The extreme faintness of this second portion, and my fear of losing the observation of the other did not permit me to make a better observation. * * * The principal part of the comet did not continue to appear of the same figure as at first. It looked quite irregular and had two very faint streaks: it was more luminous in the centre, but without any nucleus."

3. *Shooting Stars of August* 9–10, 1852.—Lieut. E. DE JONQUIÈRES, of the ship *Ville de Paris*, states (in a letter to M. Arago, printed in the *Comptes Rendus*, Sept. 13, 1852,) that on the 9th and 10th August, 1852, he was near Cagliari, Sardinia, and observed under favorable circumstances the shooting-stars which appeared at that time. The sky was clear, and the meteors were very numerous from the end of twilight. Between midnight and 4 A. M. of the 10th, the number (seen by one observer?) was about sixty-six per hour. The divergence of the meteors was quite constant from a point having a right ascension of $2^h\ 20^m$ and north declination of sixty degrees.

The next evening, (10th) the meteors appeared less abundant, but after a short time the sky became overcast, and farther observation was impossible.

VI. Miscellaneous Intelligence.

1. *Meeting of German Naturalists at Wiesbaden;* (Ath., 1852, No. 1301.)—This Society, the prototype of our British Association, has just held its twenty-ninth annual meeting in the flourishing little town of Nassau; which was well calculated, as well from the extent of its public buildings and their adaptation to scientific *réunions* and social purposes, as also from the geological interest and natural beauties of the surrounding country, for the accommodation and entertainment of so numerous a body of scientific strangers. A correspondent, who was present, has furnished us with a summary,—which, as following close on the account of our own British meeting, will probably have an interest for our scientific readers.

On the 17th of September the members began to pour into the town from all quarters of Germany; each railway train bringing its own quota of these welcome visitors, in honor of whose approach the hotels and many of the public buildings and private houses were decked out with the national flag waving from the doorways and roofs.

To be a privileged member of this Association, with the right of speaking and voting in the meetings, it is necessary to have written some work bearing on natural history, physics, or medicine; but to become a temporary associate, with the right of being present as a listener merely at all the scientific meetings, as well as of taking part in all the festive social *réunions*, is free to every one on the very moderate payment of two Prussian dollars,—equivalent to scarcely six shillings of our money. Hence, when the annual meeting takes place in a town like this, numbers of the middle and upper classes of inhabitants eagerly join it, as well as all scientific strangers who may happen to be in the neighborhood. The objects of the society, like those of the British Association, are, the formation of a mutual acquaintance between the scientific men of Germany,—and the facilitation of an early interchange of their ideas in reference to all new discoveries. The numbers who this year took part in the matter amounted nearly to 800. Of the Germans present there were considerably more than a hundred names honorably known in the records of science,—and among the foremost may be named the octogenarian, Von Buch, Prof. Rose, the great analytic chemist, Von Carnall, Inspector of Mines, from Berlin, Prof. Haidinger, Director of the Imperial Geological Institute,

Von Hauer, Von Ettingshausen, and Prof. Jäger, from Vienna, Von Leonhard and Chelius from Heidelberg, Nees von Esenbeck, the great systematic botanist, from Breslau, Gerlach, Will, and Heyfelder, from Erlangen, Wöhler, Baum, Lücke, and Weber, from Göttingen, Texter, from Würzburg, Hohl and Blazius of Halle, Forchhammer and Himly of Kiel, Seyfer of Stuttgart, Fichte, Vierordt, and Schlossberger of Tübingen, Schimper of Schwitzingen, Schmaltz of Dresden, Bach of Boppard, Rau of Bern, Lomby of Iburg, Martin of Jena, Rossmässler of Leipsic, Lehmann of Hamburgh, Weber and Budge from Bonn, Nasse from Marburg, Leuckhart, Vogel, Hoffmann, Eckhard, and Dieffenbach of Giessen, Schrötter and Müller of Aix-la-Chapelle, Müller and the two Sandbergers of Wiesbaden, Schulz of Deidishem, Prof. Stannius, Möser of Mayence, Adelmann of Dorpat, Spörex from Petersburgh, Grüsinger from Cairo, Remak, the physiologist, and a host of other names of equal significancy.

England had about twenty representatives present: including the names of Hamilton, Scoresby, Austen, Morier, Hoffmann, Lee, Hooker, Waller, &c. France had about nine or ten: of whom the most conspicuous were, Lucien Bonaparte, the Prince of Canino, Count d'Isoard-Cauvenargues, Marchal, Rigaud, Joly of Toulouse, &c.

The names of two courageous ladies were on the list of the associates; and very many others, accompanied by their male friends, graced the side benches and galleries during the general meetings, and took their seats at the festive board on the occasions of the three public dinners.

The first general sitting took place on the morning of the 18th, in the great room of the Kursaal. The President, Dr. Fresenius of Wiesbaden, opened the proceedings by a brief address on the objects of the Society and the advantages offered by Wiesbaden for their promotion:—after which the Rules were read by Dr. Braun. A report was next made on the intended monument to the memory of Oken in Jena. Von Leonhard read a paper 'On the advantages derivable from a careful Examination of the Products and Refuse of the Smelting House in reference to Geological hypotheses,' and was followed by Dr. F. Sandberger with a Report of the Geological Society of the Middle Rhine, and by Dr. Spengler 'On the Efficacy of the Waters of Ems in Bronchitis, &c.' The business of the day closed with a paper by Dr. Guido Sandberger 'On the Study of Organic Remains.'

On Sunday the 19th a public excursion was made down the Rheingau,—the railway and steamboat being put at the disposition of the learned strangers gratuitously; and on two subsequent days *fêtes champêtres* were given in their honor by the towns-people, and by the Duke of Nassau, in the picturesque sites of the Nersberg and the Plattz, with a profusion of the far-famed Steinberger and other generous growths of the valley of the Rhine.

On Monday, Wednesday, and Thursday, Sectional Sittings were held from eight to one o'clock.

On Tuesday and Friday, as on the previous Saturday, General Meetings took place in the Kursaal; in one of which Prof. Haidinger gave an interesting account of the recently formed Imperial Geological Institute of Vienna, of which he is Director. One of the first objects of

this Institute will be, the production of a series of gelogical maps of the Austrian dominions:—the whole of which gigantic undertaking may be completed, it is to be hoped, within thirty years,—beginning with Austria Proper, and proceeding gradually to the Italian, Hungarian, and Bohemian dominions. In the promotion of this plan, the Professor ascribed much credit to the exertions of his countrymen and associates, Von Hauer, Von Ettingshausen, &c.

Prof. Nees von Esenbeck, of Breslau, delivered an Address in honor of the 200th anniversary of the Leopold-Caroline Academy of Science, consisting of a brief account of its origin and labors; and was followed with a clever paper by Dr. Posner 'On the Influence which the Medical Profession ought to exercise on the Sanitary condition of their Fellow Men,'—a point on which the future welfare of the human race so mainly turns.

At the Third General Meeting (Friday) papers were read by Prof. Nees 'On the Responsibilities of the State in regard to Epidemics,'—which will be published in the Reports; by Herr Voltz 'On the Tertiary Basin of Mayence;' and by Dr. Rossmässler 'On the Importance of multiplying Associations for Scientific Objects.'

For the Meeting of the following year, the university town of Tübingen was fixed on.

In the Sectional Meetings the original communications and discussions were so numerous, that we must limit ourselves to a partial mention of them.

In the Physical Section, Prof. Müller presented 'A Table of General Formulæ for Crystallography.' Prof. Magnus 'On the Deviation of Projectiles.' Prof. Langsdorf 'On the Conducting Power of Silver.' Prof. Müller showed an Apparatus for displaying the Evolution of Caloric on the freezing of Water, and elucidating the formation of Hail, &c.'

In the Chemical Section,—Prof. Von Heinz 'On Animal Fats.' Prof. Seybel 'On the Progress of Chemical Manufactories in Austria.' Prof. Schödler 'On the Carbonization of Wood under Water.' Prof. Hoffmann 'On the Employment of Gas-burners in the Elementary Analysis of Organic Substances, &c.'

In the Geological Section, Prof. Zimmermann 'On very Recent Formations of Sulphur.' Prof. F. Sandberger 'On the Geology of Nassau.' Prof. Kurr 'On Fossil Human Teeth'—considered, however, by Prof. von Meyer to be, like other human fossil bones, probably postdiluvial. Prof. Klipstein 'On the Geological Formation of Hessia.' Prof. Austen 'On the Valley of the British Channel and Accumulations within it.' Prof. Dumont 'Comparison of the Geological Formations of England and Belgium.' Prof. von Hauer 'On the Tertiary Formation of the Basin of Vienna.' Prof. Schwarzenberg 'On the Geology of Algiers, &c.' Prof. von Ettingshausen 'On Filices, &c. in Coal Formation of Stradonitz near Beraun.' Prof. Desor 'On Parallel Phenomena produced by Diluvia and Glaciers in Scandinavia, Switzerland and North America.' Prof. Braun 'On Fossil Grapes at Salzhausen.' Prof. von Meyer and Prof. Thiollière 'On Vertebrata' in the newly-discovered lithographic Slate of Cerin, in France. Prof. Forchhammer 'Proposed Formation of a Sub-marine Chart of the Mediterranean.' Prof. Lesquereur 'Formation of Turf, &c.'

In the Botanical Section, Prof. Hoffmann 'On the Influence of River Boundaries on the Distribution of Plants.' Prof. Schimper 'On the Proposed Spirological Arrangement of Plants.' Prof. Fresenius 'On the Fungus of the Grape Disease.' Prof. Lehmann 'On the Development of Heat by the *Victoria Regina*.' Prof. Schucht 'On the Multiplication of Orchideæ by Bulbs.' Prof. Wirtgen 'On the Genus Mentha.' Prof. Hoffmann 'On the Red Fungus on the Potato in Westphalia.' Prof. Schenk 'On the Cultivation of the Silk-worm in Nassau.' Prof. Löhr 'On the Occurrence of South German Plants in the North, and *vice versâ*.' Prof. Seemann 'On the Fatty Substance obtained from the Euphorbiaceous Plant, *Stillingia sebifera*, very largely used for Stearine Candles in England.' Prof. Brandis 'On Atmospheric Showers of small black round Fungus (*Sclerotium semen*) near Cologne.'

Zoology,—Prof. Lee 'On the Dependence in Mammalia of the Spinal Cord on the Brain.' Prof. Vierordt 'On the Facilitating of the Counting of Blood-globules.' Prof. Stilling 'On the Microscopic Structure of the Central Nervous Organs.' Prof. Gerlach 'On the Cutaneous Papillæ and newly-discovered Special Pyramidal Organs of Touch,' contrary to Wagner, he discovers vascular ramifications in all of them. Prof. Hering 'On the Period of the Circulation'—above half a minute in the horse, not accelerated with respiration or beat of the heart. Prof. Budge 'Influence on the Pupil of the Frog of the Section of the Anterior and Posterior Spinal Roots.' Prof. Moleschott 'Diminution of Carbonic Acid in Respired Air, and of Red Globules in Blood, on removal of the Liver and Spleen in Frogs,'—and 'On the Formation of Sugar in Animals dependent on the Liver.' Prof. Will 'On the Hair of Caterpillars'—being tubes containing formic acid. Prof. Remak 'Fœtal Development of Vertebrata,'—the flat germ of birds consists of three layers, sensorial, motory and glandular and intestinal. Prof. Schiff 'Atrophy of Bone from Section of Nerves.' Prof. Meyer 'On the Microscopical Structure of the Nervous Fibres and Ganglia, and on the shortening of the Nerves in the Leech by a Muscular Sheath.' Prof. Waller 'On the Functions of the Ganglia and Spinal Marrow, as investigated by the Section of Spinal Roots.' Prof. Schlossberger 'On the Chemical Constitution of the Brain in different Animals and Ages.' Lucien Bonaparte 'On some New Species and Arrangement of Birds.' Prof. Rossmässler 'On the Necessity of an Anatomical Investigation of the Conchyliæ.' Prof. Calwer 'On the Development of the Buccinum Matatum;' wherein several ova go to the formation of one individual, whilst from the egg of the Tubularia, on the contrary, as shown by Beneden, several embryos come from one ovum. Prof. Joly 'On the real External Source of the Blue and Red Coloration of the Cocoon of the Silk-worm.'

Medical Section,—Prof. Rau 'Gutta Percha Ear-tubes and Probes.' Prof. Greisinger 'Typhus in Egypt'—characterized by bilious symptoms and by enlargement of spleen. Prof. Höfle 'On Microscopic Fungus occurring in Mucous Exudations.' Prof. Naumann 'On Exophthalmos in connexion with Enlargements of Thyroid and Heart.' Prof. Snell 'Loss of Cutaneous Sensibility, frequent in the mentally deranged;'—18 cases of entire loss, 160 of partial. Prof. Erlenmeyer 'On Derangements in the Sense of Touch, and their Relation to Mental Disease.'

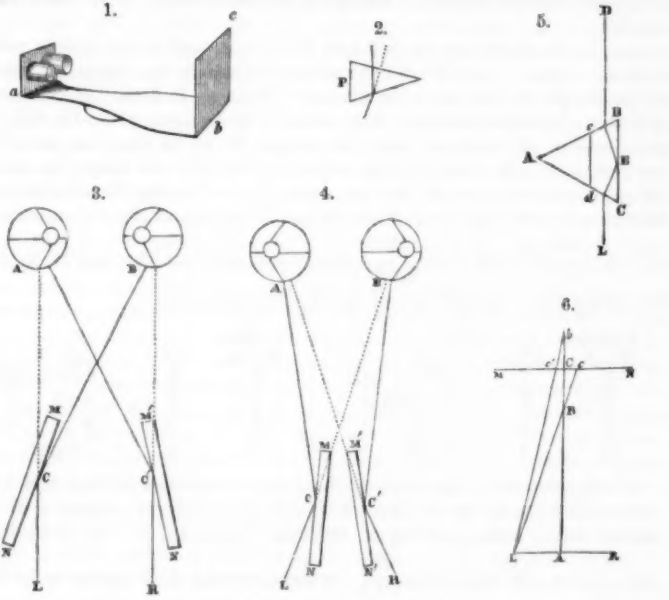
2. *Stereoscope.*—A simple form of this ingenious instrument of Wheatstone is represented in fig. 1, on the next page. It is a variety of the instrument suggested by Brewster. In its cheapest style, it is made of Japanned sheet tin. The one here figured was 6 inches in length; the upright back measured 6 inches long by $3\frac{1}{2}$ high; and the front $4\frac{1}{2}$ inches long by $1\frac{7}{8}$ high; the distance between the centres of the eye-holes $2\frac{1}{2}$ inches. Below at middle is a handle for holding it. The two pictures to be viewed (one drawn as the object would appear a short distance off to the left eye, the other, as to the right eye, and the two on one piece of paper, the requisite distance apart) are placed against the back piece *bc*. On looking through the eye-pieces, the two pictures are superimposed at the middle point between them, and are seen as one; the several objects appear at their proper distances, in advance of one another; moreover every part stands out in bold relief, heads looking like stationary, etc. This superposition of the two pictures, which is due to a slight bending of the rays of light, may be produced by different kinds of eye-pieces. The following are among those that are suggested by Brewster. (1.) Two half-lenses (made by dividing a lens along a diameter), one for each eye-hole. The eye-aperture is circular, and the centre of the two apertures should pass through corresponding points of the semilenses, that is, be at equal distances from corresponding margins. The distance between the centres of the eye-pieces should equal the distance between the centres of the pupils of the eyes. They may be made so as to admit of adjustment for different eyes. This kind of instrument is called the *lenticular stereoscope*.

(2.) In a second kind, (the *prismatic stereoscope*,) a prism with a small angle is used (fig. 2) in the same manner essentially as the semilenses. A piece of window glass ground down on one side, or two thin plates of glass placed together at a small angle, with a drop of water between, will answer the purpose.

(3.) In a third *kind*, (the *reflecting stereoscope*,) the rays of light are bent by reflection from plates of black glass; common glass covered on one side with black sealing wax will answer. Two varieties are here figured from Brewster. In figure 4 the pictures (A, B,) have the reverse position they have in figure 3, owing to the reflection being reversed. The second is the more compact kind, and may be easily arranged in a tube. Even a single piece of glass, like the left one of either of these figures, is all that is necessary, the eye seeing the other picture direct and the angle of reflection being such as to superimpose the two in this mode of viewing them. The reflecting stereoscope is most easily adapted to eyes of different focal distances, and also to pictures of different sizes. The semilenses have the advantage of magnifying the pictures.

(4.) Another of Brewster's stereoscopes is the *Total Reflexion Stereoscope*. The left eye looks through a prism (fig. 5) from L, and sees one of the pictures at D, the ray refracted in the prism being totally reflected at E, while the other picture is seen direct with the other eye. The slight difference in the distance of the eyes from the superimposed pictures produces no appreciable injury to the effect. It is essential that the angles of the prism ABC and ACB should be equal. If the surfaces AB and AC are made convex by annexing to each a plano-convex lens, this kind of stereoscope then magnifies the objects seen.

In the above we have given only the simpler forms of the stereoscope for the sake of illustrating the principle on which it is constructed. They are forms that might be made without the aid of an optician.



To determine the required distance between the pictures, look at one picture with one eye-piece, and after obtaining the distance off for the best view, note how far the picture is displaced laterally by refraction, and then make the distance between the pictures or corresponding parts in the pictures, equal to twice this amount of displacement. In figure 3, the instrument would show a raised cone: but if B and A are transposed, it would give a hollow cone; or by using three figures, placing another B (which we may designate B′) to the left of A, the hollow and raised cone may be seen, alternately, according as B′ or B is superimposed on A. The small circle at the centre of each figure, although alike in all three, would *appear* larger in the raised cone than in the hollow cone, since in the former it would *seem* to be nearer the eye—an exact illustration, as Brewster states, of the difference between the apparent size of the moon near the horizon and at considerable altitudes.

Brewster also describes a binocular camera for making the pairs of drawings of any objects however large, and even of scenery, which are required for exhibition in the stereoscope. The difference in the two views will be at once apprehended on shutting first one eye and then the other, and observing the difference in the relative parts of an object thus seen, arising from the distance between the eyes. To obtain pictures of the two kinds of the requisite nicety for use in the stereoscope, photography or a binocular camera is required.

A camera with several adjustments for producing stereoscopic pictures was described at the recent meeting of the British Association by Mr. A. Claudet (see page 124).

Brewster gives the following directions for drawing on a plane the dissimilar representations of solids for the stereoscope (Phil. Mag. [4], iii, 16):

Let L, R, fig. 6, be the left and right eye, and A the middle point between them. Let MN be the plane on which an object or solid, whose height is CB, is to be drawn. Through B draw LB, meeting MN in *c*; then if the object is a solid, with its apex at B, C*c* will be the distance of its apex from the center C of its base, as seen by the left eye. As seen by the right eye R, C*c'* will have the same value, but *c'* will lie on the left side of C. Calling E the distance between the two eyes, and *h* the height BC of the solid, we shall have $AB : h = \frac{E}{2} : Cc$ and $Cc = \frac{hE}{2AB}$, which will give us the results in the following table, AC being =8 and E=2½ inches:—

Height. BC=*h*.	AB.	Cc.	Height. BC=*h*.	AB.	Cc.
1	7	0·279 inch.	5	3	2·088 inch.
2	6	0·4166 "	6	2	3·75 "
3	5	0·75 "	7	1	8·75 "
4	4	1·25 "	8	0	Infinite.

If we now wish, by directing the axes of the eyes beyond MN to *b*, to ascertain the value of C*c'*, which will give different depths *d* of the ***hollow*** solids corresponding to different values of C*b*, we shall have $Ab : \frac{E}{2} = d : Cc'$ and $Cc' = \frac{dE}{2AB}$; which, making AC8 inches as before, will give the following results:—

Depth. C*b*=*d*.	A*b*.	Cc'.	Depth. C*b*=*d*.	A*b*.	Cc'.
1	9	0·139 inch.	7	15	0·58 inch.
2	10	0·25 "	8	16	0·625 "
3	11	0·34 "	9	17	0·663 "
4	12	0·4166 "	10	18	0·696 "
5	13	0·48 "	11	19	0·723 "
6	14	0·535 "	12	20	0·75 "

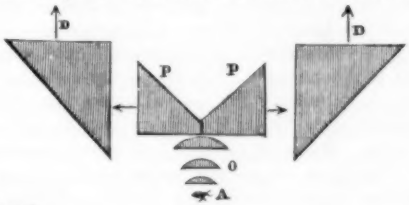
The values of *h* and *d*, when the excentricities C*c*, C*c'*, as we may call them, are known, will be found by the formulæ $h = \frac{Cc E}{2AB}$ and $d = \frac{Cc' E}{2AB}$.

As C*c* is always equal to C*c'* in each pair of figures or dissimilar pictures, the depth of the ***hollow*** solid will always appear much greater than the height of the ***raised*** solid one. When C*c* and C*c'* are both 0·75 $h : d = 3 : 12$, and when they are both 0·4166, $h : d = 2 : 4$, and when they are both 0·139 $h : d = 0·8 : 1·0$.

3. *Pseudoscope of Wheatstone*, (Phil. Mag. [4] iii, 151.)—As this instrument conveys to the mind false perceptions of all external objects, the author calls it a Pseudoscope. It consists of two reflecting prisms,

placed in a frame, with adjustments, so that, when applied to the eyes, each eye may separately see the reflected image of the projection which usually falls on that eye. This is not the case when the reflection of an object is seen in a mirror; for then, not only are the projections separately reflected, but they are also transposed from one eye to the other, and therefore the conversion of relief does not take place. The pseudoscope being directed to an object, and adjusted so that the object shall appear of its proper size and at its usual distance, the distances of all other objects are inverted; all nearer objects appear more distant, and all more distant objects nearer. The conversion of relief of an object consists in the transposition of the distances of the points which compose it. With the pseudoscope we have a glance, as it were, into another visible world, in which external objects and our internal perceptions have no longer their habitual relations with each other. Among the remarkable illusions it occasions, the following were mentioned. The inside of a tea-cup appears a solid convex body; the effect is more striking if there are painted figures within the cup. A china vase, ornamented with colored flowers in relief, appears to be a vertical section of the interior of the vase, with painted hollow impressions of the flowers. A small terrestrial globe appears a concave hemisphere; when the globe is turned on its axis, the appearance and disappearance of different portions of the map on its concave surface has a very singular effect. A bust regarded in front becomes a deep hollow mask; when regarded *en profile*, the appearance is equally striking. A framed picture, hung against a wall, appears as if imbedded in a cavity made in the wall. An object placed before the wall of a room appears behind the wall, and as if an aperture of the proper dimensions had been made to allow it to be seen; if the object be illuminated by a candle, its shadow appears as far before the object as it actually is behind it.

4. *Riddell's Binocular Microscope.*—On page 68 Dr. Riddell has given a description of this important instrument. As figures, which we are expecting from him have not arrived, we copy the following from a letter of his, published in the Boston Traveller of Dec. 8.



A. Object to be seen.
O. Objective combination.
P P. Two rectangular prisms of fine glass, separating the rays by internal reflection, at 45°.
D D. Outer rectangular prisms, adjustable, for different distances between the eyes. These send each bundle of rays, in the direction denoted by the arrows, to be received by the oculars and erectors, also adjustable.
A O, P P, may be inverted, or turned half way round, so that the object will be above.

Dr. Riddell prefers to have the stage fixed, and the slow motion for adjusting the focus of the objective, made to affect the whole structure —O, PP, DD.

5. *On the Koh-i-noor Diamond;* by Prof. TENNANT, (Athenæum, No. 1300.)—At the last meeting of the British Association, Dr. Beke read a paper 'On the Diamond Slab supposed to have been cut from the Koh-i-noor.' He stated:—"At the capture of Coochan there was found among the jewels of the harem of Reeza Kooli Khan, the chief of that place, a large diamond slab, supposed to have been cut from one side of the Koh-i-noor, the great Indian diamond now in the possession of Her Majesty. It weighed about 130 carats, showed the marks of cutting on the flat and largest side, and appeared to correspond in size with the Koh-i-noor." Prof. Tennant was induced to record his opinion of the probability of this being correct. He had made models in fluor spar, and afterwards broken them, and obtained specimens which would correspond in cleavage, weight and size with the Koh-i-noor. By this means he was enabled to include the piece described by Dr. Beke, and probably the large Russian diamond, as forming altogether but portions of one large diamond. The diamond belongs to the tesseral crystalline system: it yields readily to cleavage in four directions, parallel to the planes of the regular octahedron. Two of the largest planes of the Koh-i-noor, when exhibited in the Crystal Palace, were cleavage planes,—one of them had not been polished. This proved the specimen to be not a third of the weight of the original crystal, which he believed to have been a rhombic dodecahedron; and if slightly elongated, which is a common form of the diamond, would agree with Tavernier's description of it as bearing some resemblance to an egg. Sir D. Brewster made some observations, and stated that the English translation of Tavernier's work left out the minute details which were fully given in the original. Sir David expressed his satisfaction with Mr. Tennant's illustration,—which clearly proved the diamond to be only a small part of a very large and fine stone.

6. *On Glynn and Appel's Patent Paper for the prevention of Piracy and Forgery by the Anastatic Process;* by S. BATESON, Esq., (Athenæum, No. 1300.)—As some may be unacquainted with the nature of the Anastatic process itself, and of the abuses of which it is capable in unscrupulous hands, I think it right, in the first place, to give you a short account of its history, nature, and progress. It was invented some eight or nine years ago by Mr. Rudolph Appel, a native of Silesia, who came over to this country. Owing to various circumstances, the Anastatic printing languished for several years, until tardy justice was done to its inventor at the Great Exhibition in 1851, when a prize medal was awarded him. Since that time it has been becoming more generally known. The term 'Anastatic' means rising up, or a reproducing as it were, and very significantly does the name express the result; for by it any number—thousands upon thousands—of reproductions of any printed document may be obtained, each of which is a perfect *fac-simile* of the original, no matter how elaborate the engraving may be, or how intricate the design.

I will now endeavor to describe the actual operation of Anastatic printing. The print of which an Anastatic copy is required is first moistened with very dilute nitric acid (one part of acid to seven of water), and then being placed between bibulous paper, all superabund-

ance of moisture is removed. The acid being an aqueous solution, will not have attached itself to the ink on the paper, printers' ink being of an oily nature; and if the paper thus prepared be placed on a polished sheet of zinc and subjected to pressure, two results follow:—In the first place, the printed portion will leave a set-off or impression on the zinc; and secondly, the nitric acid attached to the non-printed parts of the paper will eat away and corrode the zinc, converting the whole, in fact, into a very shallow stereotype. The original being removed (perfectly uninjured), the whole zinc plate should next be smeared with gum-water, which will not stick to the printed or oily part, but will attach itself to every other portion of the plate. A charge of printers' ink being now applied, this in its turn only attaches itself to the set-off obtained from the print. The final process consists in pouring over the plate a solution of phosphorous acid, which etches or corrodes more deeply the non-printed portion of the zinc, and produces a surface to which printers' ink will not attach. The process is now complete, and from such a prepared zinc plate any number of impressions may be struck off.

The uses to which this invention may be applied are various. Copies of rare prints may be obtained without the aid of an engraver. Reproductions of books, or of works out of print, may be had without setting up the type; authors may illustrate their own works, and amateur artists may have fac-similes of pen-and-ink sketches at a very inconsiderable expense. To be in accordance with the facts already mentioned, the anastatic process should only be applicable to the copying of impressions made with printer's ink; any other inks, however, even the most fugitive, may be adapted to this operation, and hence, without some safeguard, the dishonest practices to which the anastatic process might be applied would be numerous. Copies of cheques and bank notes may be taken so as to defy scrutiny. In point of fact, bankers have been mistaken again and again when examining notes and cheques forged by this process; and as I have now endeavored to impress upon you the laws, I will shortly describe the antidote which is offered by the patent paper invented by Messrs. Glynn & Appel. It is as beautiful from its simplicity as it is efficacious in its operation. It consists merely in impregnating or dyeing the pulp of which the paper is made with an insoluble salt of copper. After a series of experiments, the patentees preferred phosphate of copper to any other salt; and for this purpose, sulphate of copper and phosphate of soda are successively mixed with the pulp, which, of course, produce an insoluble salt, the phosphate of copper. Besides this, a very small portion of a peculiar oily and non-drying soap is introduced, which affords a double protection. Should the forger attempt to submit a note or cheque printed on the patent paper to the anastatic process, a film of metallic copper separates between the paper and the zinc, not only preventing a set-off, but cements the paper so strongly that the paper must be destroyed—it can only be removed in small pieces. Thus, the forger is punished by the loss of the original, the public protected, and the banker benefitted, as it is presumed no forger would apply for the value of the note so unlawfully used. Hitherto, elaborate engraving, beauty of design, and execution by skillful hands have been the sources of pro-

tection, and under such conditions a forger must either be a skilful engraver, or employ some person to engrave for him. This fact has generally led to the detection of forgery; but you can easily imagine how justly alarmed bankers will become when they learn that any one who understands what is called chemical, that is to say, lithographic printing, may, with the aid of a zinc plate, a little nitric acid and a press, be able to produce such perfect fac-similes of notes and cheques as to pass the scrutiny of the most lynx-eyed of their clerks. You will agree with me that it would be wrong, if not criminal, to publish to the world so dangerous a process to facilitate forgery, unless I were, at the same time, to produce a safeguard which would absolutely defeat such attempts.

4. *Notice of the "Ice Spring" in the Rocky Mountains*, (from a letter of Geo. Gibbs, Esq.)—The Ice Spring, so called, is considered by the mountaineers as one of the curiosities of the great trail from the States to Oregon and California. It is situated in a low marshy "swale" to the right of the Sweetwater river, and about forty miles from the South Pass. The ground is filled with springs, and about eighteen inches beneath the turf, lies a smooth and horizontal sheet of ice, which remains the year round, protected by the soil and grass above it. At the time of our passing, July 12th, 1849, it was from two to four inches thick, but our guide told us that he had seen it a foot deep. It is perfectly clear, and beautifully disposed in hexagonal prisms, separating readily at the natural joints. The ice has a slightly saline taste, the ground about it, as with the Sweetwater and Platte river country generally, being impregnated with salts, and the water at one spot near by tasted of sulphur. Not the least singular circumstance was the smoothness of the upper surface of the stratum, although formed beneath the soil.

5. *Mollusca of the West Indies.*—Prof. C. B. Adams of Amherst College, Mass., who has been engaged in personal explorations of the West Indies, and has described a large number of its Mollusca, is desirous of obtaining further facts relating to the distribution of species, and invites the coöperation of any who are willing to aid him. He states that parcels may be forwarded to him through Robert Swift, Esq., of St. Thomas, W. I., J. H. Redfield, Esq., 16 South st. N. York City, or J. M. Murray & Co., Booksellers, 139 Atlantic st., Brooklyn. Specimens of doubtful locality would be of little value, and the locality should be minutely stated. In all cases when desired, he will return other shells in exchange, for which exchanges he is well furnished with species from all parts of the world.

6. *Earthquake in New England.*—On Saturday night, the 27th of November last, near midnight, an earthquake was felt at Salem, Beverly, Woburn, Groton and Wenham in Massachusetts, and also at Exeter in New Hampshire. The shock lasted about thirty seconds, and aroused the people from their slumbers, causing a sensible shaking of the houses, etc.

7. *Fossil Elephant.*—The Zanesville (Ohio) Courier reports the recent discovery of a fossil Elephant on the line of the Central Ohio railroad, on the river in the eastern part of Zanesville, in a tolerably good state of preservation. This is the third of the same species that has been discovered in this bank within a few years. One of the tusks

was sound, but broken off 8 feet from its base; its circumference at the lower end was 26½ inches, at the upper 16½. Two of the molars weigh 20 lbs. each, and two 14 lbs.

8. *Gold in Vermont;* by Prof. O. P. HUBBARD, (from a letter dated Hanover, N. H., Dec. 9, 1852.)—To-day, Mr. Kennedy of Plymouth, Vt., southwest of Woodstock, has brought me some specimens of gold found in *Bridgewater*, west of Woodstock, in spongy or mossy pieces, scales and knobs, which were all taken from the gangue; also in white quartz and in ferruginous quartz more or less covered with the red oxyd of iron, associated with galena and copper iron pyrites.

OBITUARY.

GIDEON ALGERNON MANTELL, LL.D., F.R.S., F.G.S., &c., died at his residence in Chester Square, London, November 10th, aged, we believe, about sixty-four.

Often, during our editorial career of thirty-four years, have we been called to the painful duty of recording the death of men, coadjutors with us in the cause of science, and of not a few with whom we have been connected by ties of personal friendship; but never have we been so painfully surprised, as by the recent announcement of the sudden death of the eminent and excellent man named above.

Thirty years ago, his splendid quarto of 320 pages, with 43 plates, devoted to the geology of Sussex, his native county in England, made its appearance. It was followed, at the end of five years, by a thinner quarto, equally a finished production, with 21 plates illustrative of the geology of the southeast of England, including Sussex and Tilgate forest. These original works, abounding with interesting and instructive observations, established the author's reputation throughout Europe as an able geologist, and as an acute and successful expositor.

The scene of his personal researches in geology, commencing at Lewes, his native town, extended from London and its vicinity to Brighton on the English channel, and from Dover to the Isle of Portland, including Hampshire and the Isle of Wight, and never was a geological field more faithfully or more successfully explored. Dr. Mantell made also occasional excursions into Wales and Derbyshire, to Oxford, Edinburgh, &c. The fossils of the chalk, and the colossal reptiles of the Wealden formation below the chalk, make a conspicuous figure in his works, among a multitude of other organic relics of early creations.

Dr. Mantell lived successively at Lewes, Brighton, Clapham and London, in all of which places he sustained an extensive professional practice, both in medicine and surgery, and still found time, in consequence of his great industry, to cultivate geology and the allied sciences, especially comparative anatomy, and to give many lectures on these subjects, in compliance with invitations from various towns and cities. As a lecturer, he was lucid, animated and eloquent; and having the advantage of a noble presence, with a voice of great power and of a fine musical cadence, his appearance was eminently attractive. He had a perfect command of the most appropriate language, and his chastened enthusiasm always carried his audience along with him. His well deserved celebrity insured on the part of the public a welcome reception to several important works, which, in the course of a few years, he wrote and published.

The Wonders of Geology, in 2 volumes, was an embodiment and enlargement of his lectures, and a more instructive and delightful work on that science has never been produced. It passed through several editions in England; and an American edition (printed in London) was published, prefaced by an introductory discourse intended to adapt the work more particularly to this country.

The *Medals of the Creation*, also in two volumes, contained a learned and instructive synopsis of the fossils of all ages, and was illustrated by numerous excellent figures.

The *Geology of the Isle of Wight*, in one volume, gave a full and faithful account of that beautiful and remarkable island, replete with fossils and containing in its lower strata, limbs, vertebræ and other bones of ancient reptiles more colossal than any that had been before discovered. This work also is fully illustrated.

Nearly the last of Dr. Mantell's great labors was a digested account of the fossils in the British Museum, with illustrations; it forms a thick volume, and is entitled *Petrifactions and their Teachings*. It is a very interesting and instructive guide through the British Museum, and is fitted to be a pioneer in palæontology generally.

Among his smaller works—the *History of a Pebble*—was a charming little book, adapted to the capacity of young people and even of children, while it was acceptable to the mature geologist; it passed through many editions.

Two thin quartos, amply illustrated (as usual with the author), one on the Fossils of Sussex, and the other on the Geology of Leith Hill, are gems in geology.

His *Days' Walk around Lewes*, is an excellent guide in that region, both in geology and archæology. On archæology as regards the proofs of the existence of man in different geological eras, he delivered an important lecture before the Archæological Society of Oxford University.

To the list of Dr. Mantell's works, we add a handsome quarto narrative of the visit of William IV. and of Queen Adelaide at the ancient borough of Lewes, with original poetry and portraits. Also Thoughts on Animalcules, and a splendid Pictorial Atlas of fossils, the illustrations chiefly selected.

Of his numerous memoirs, those on the fossil reptiles of the southeast of England—on the Belemnite and Belemnoteuthis—and on the Moa,* the extinct fossil bird of New Zealand, are among the most remarkable.

He was employed, near the close of his life, in revising the Medals of the Creation for a new edition, in which he was remodelling it so far as to make it almost a new work; but the delay in the printing caused him much uneasiness. The revision has been left by him in an unfinished state, and it is earnestly to be hoped that some scientific friend, equal to the undertaking, will resume the work and carry it through.

Dr. Mantell, a number of years ago, sustained a severe injury on the spine, in consequence of a fall from his carriage, and an incurable tumor arose, which by its pressure upon the nerves of the spinal chord,

* His eldest son, Mr. Walter Mantell, living in New Zealand, obtained and sent to his father a large collection of the bones of the Moa.

produced at first temporary paralysis, and subsequently through life, frequent and intense neuralgic suffering, attended by great emaciation. Still his powerful and enthusiastic mind rose above his sufferings, although they often deprived him of sleep. He wrote several of his works while he was a martyr to pain; at the same time he continued his professional visits, and at the bed side of his patients, and when in society at home or abroad, he assumed a degree of cheerfulness which might have led any one to suppose that he was in perfect health. During the last week of his life he suffered intensely, and was deprived almost entirely of sleep; still, although observed to look unusually ill, he gave a public lecture, with his usual animation, two days before his exit, and visited his patients the very day before he died. He also continued to labor upon the Medals, until he retired to his chamber, on the night preceding his decease. He was then in great suffering; and at 3 o'clock P. M., of November 10, he passed gently away without a struggle, and probably was never conscious of his transition, until his spirit awoke in another world.

As a personal friend, Dr. Mantell was most interesting and estimable. His affections were warm, his intellectual perceptions acute, and his capacity for social enjoyment was so great, that the presence of a friend aroused his active mind even when suffering intense pain; his powers instantly rallied and poured forth treasures of knowledge and often literary and poetical effusions with a natural eloquence and finished grace which made him a most delightful companion. In affairs of business, he was ever exact and responsible, and as far as possible, left no pecuniary transactions to be finished by other hands.

He was an elegant artist; his off-hand pen or pencil sketches, occasionally enclosed in letters to his friends, were both elegant and effective, and most of his illustrations in his earlier works were drawn by himself. It is stated on the title-page of the Geology of Sussex, that the drawings were made by the author and the engravings were executed by Mrs. Mantell. This lady and three children survive.

Dr. Mantell's ancestors were distinguished in several of the arbitrary reigns of England, as friends of human liberty, and some of them paid the price of their blood.

Dr. Mantell was remarkable for his candor and kindness, and for scientific justice,* especially to original discoverers, whether eminent or humble, and no British philosopher excelled him in liberality and courtesy towards the scientific and literary productions of this country and their authors.

Although he sold to the British Museum some years since the greater part of his vast collection of fossils of the southeast of England, his private dwelling was still a rich museum of most interesting objects of nature and art:—every thing conspired in perfect unity, to one

* Dr. Mantell transmitted to Baron Cuvier the then (1822) newly discovered teeth of the gigantic fossil reptile, since named the Iguanodon; and in the record of Cuvier's opinion quoted by Dr. Mantell in his Geology of Sussex and Fossils of Tilgate Forest, 1827, p. 71, are the following expressions, which prove that he gave to the illustrious Cuvier the credit which was his due:

"Ces dents me sont certainement inconnus—je crois qu'elles appartient—à l'ordre des reptiles—n'aurious nous pas ici un animal noveau, un reptile herbivore?"

effect, corresponding with the accurate science and elegant taste of the lamented proprietor. The rare combination of exact and thorough scientific knowledge with the enthusiasm of a discoverer and the rich but chastened diction of a poet, were never more remarkably united than in him. His letters were a rich feast to his friends. Full of information and thought, and the kindest feelings, and being punctual in responding to letters addressed to him, those who were so happy as to enjoy his confidence and correspondence always hailed with joy his beautiful and well known inscriptions.

Dr. Mantell's early training in religion was under pious parents, and his retentive memory enabled him when young to repeat a large part of the Bible by heart. This statement, which came to us from his own lips, is in accordance with a fact which illustrates the power of his memory, that, in conversation, he would often repeat with perfect facility and accuracy, whole pages of his favorite English classics, and with that finished and graceful intonation for which he was so remarkable.

B. S., Sr.

Dr. Daniel Drake.—Dr. Drake died in Cincinnati, his place of residence, Nov. 7, aged 67 years. We defer to another number a farther obituary of this distinguished man.

Dr. Pfaff, senior of the Professors of the Royal University of Kiel, has died within a few months past, at the age of 79.

VII. Bibliography.

1. *First Principles of Chemistry ;* by B. Silliman, Jr., third edition, 555 pp. 12mo. Philadelphia, Loomis & Peck.—This work has been throughout revised and to a great extent re-written by the author, and it has thus been brought up to the present state of the science. Moreover the illustrations have been much increased in number.

The latter portion of the volume, embracing about 160 pp., is an introduction to Organic Chemistry, by Mr. T. Sterry Hunt, Chemist to the Geological Commission of Canada, and has been re-written by him for the present edition. The author is well known to our readers, by his various communications to the Journal of Science during the last six years, and we find many of his peculiar views embodied in the treatise before us. Although limited in its plan, and intended as a work for the young student, there are many points of interest and novelty which render the book not unworthy the notice of more advanced scholars.

The theory of chemical changes announced by Mr. Hunt, is very simple. The changes are reduced to two cases; direct union on the one hand, and direct division on the other: either of these may occur independently of the other, but they are very often united; the body formed by the first process is directly broken up by the second, and if the affinities which produced the union have been subverted, the results of the division are unlike the original factors, and we have the case of double decomposition, or equivalent substitution, in which process he supposes that direct union always forms an intermediate stage. This is illustrated by the case of olefiant gas $C_4 H_4$, which unites directly with Cl_2, to form the body $C_4 H_4 Cl_2$; this under certain conditions may break

up into H Cl, and $C_4 H_3 Cl$, these being products of substitution from $C_4 H_4$, and from Cl_2; for these decompositions are always reciprocal, and $C_4 H_3$ is *equivalent* to Cl and to H. The author insists that the notion of equivalents has been too much restricted by the definitions imposed at an early period of the science, and with Gerhardt considers fifty-eight parts of manganese in permanganic acid, to be as truly the equivalent of Cl and of H, as twenty-eight parts are in the protosalts, or eighteen and two-thirds parts, in the persalts of that metal. Organic is distinguished from inorganic chemistry, as being the chemistry of the carbon series, including all those bodies which evolve carbon in their ultimate chemical analysis. But even this distinction is arbitrary, and there are groups of homologous bodies which unite the two divisions. Hydrogen, in its equivalent of four volumes, and represented as H_2, is regarded as a type of all the hydrocarbons, and the homologue of such as are represented by $(C_2 H_2)n H_2$; while hydrochloric acid, H Cl, the metals, M_2, and the hydrid of copper of Wurtz, $Cu_2 H$, or Cu H, in which *cuprosum*, or copper in twice its ordinary equivalent, replaces H, are species of the same type.

Water, represented as $H_2 O_2$, and equal to four volumes of vapor, is in the same way bibasic, being the prototype of oxyds, hydroxyds, and sulphids, and the functional homologue of the alcohols, and ethers of the formula, $(C_2 H_2)n$, $H_2 O_2$. All the other ethers are homologous with their parent acids. These important relations, since recognized by Gerhardt and Laurent, were first pointed out by the author, in the pages of this Journal.*

The peroxyds like $Ba_2 O_4$, and the corresponding sulphids, are not regarded as bodies in which the metal unites in a less equivalent than in the protoxyds, but, from analogy with the higher sulphuretted ethers, as protoxyds and protosulphids, which have directly fixed O_2 and S_2, without change of volume.

While he rejects the terminology of the compound-radical theory, the author maintains the principle insisted upon by Liebig that the ethers are analogous to salts, and that a group like $(C_2 H_2)n$ H, equivalent to H, may be substituted in acids, for the hydrogen replaceable by a metal, thus explaining the loss of basicity, which the hypothesis of Gerhardt leaves unaccounted for. This question has been treated at length by the author in this Journal.†

In describing the cyanic compounds, he suggests that oxygen may be looked upon as replacing carbon in many bodies, without any change of type. $C_2 H_2$, and C_2 H N, are thus assimilated to water $O_2 H_2$, while cyanogen, $C_4 N_2$, corresponds to peroxyd of hydrogen, $O_4 H_2$, and thus the fixing of the cyanic elements, is to be compared to the combination of water. In the case of the hydrocyanic ethers, the substitution of C_2 H N for the $O_2 H_2$ of any alcohol, enables us to add C_2 to the group, and thus to rise to the acid of an alcohol higher in the organic scale.

The polycyanids, whose equivalent he finds in the liquid obtained by Bouis in acting with chlorine, aided by sunlight, upon a hot saturated solution of cyanid of mercuy, and having the formula $C_{12} N_4 Cl_{14}$,

* March, 1848, p. 265, and July, 1849, p. 91, et seq.
† May, 1849, p. 399, and July, 1849, p. 89.

contain generally six equivalents of hydrogen or a metal; the ferrocyanids being $C_{12}\,Fe_2\,M_4\,N_6$, and the ferricyanids, containing iron in two-thirds its ordinary equivalent, $C_{12}\,Fe_3\,M_3\,N_6$. These two salts are respectively quadri- and tribasic, but in the nitroprussids the first form has lost H_2 becoming bibasic, and the new type will be $C_{12}\,Fe_2\,M_2\,N_6$; while in the salts of Playfair, O_2 has replaced C_2, or $N\,O_2$, is substituted for $N\,C_2$, and the formula becomes $(C_{10}\,O_2)\,Fe_2\,M_2\,N_6$; a constitution which, in another form, Gerhardt has shown to correspond perfectly with the analytical results obtained by Playfair.

A similar view is extended to the nitric species of the hydrocarbons, and nitrobenzene, $C_{12}\,H_5\,N\,O_4$, is compared with bitter-almond oil, $C_{14}\,H_6\,O_2$, by writing its formula $(C_{12}\,O_2)\,(H_5\,N)\,O_2$. This novel suggestion seems deserving of farther attention.

In treating of the oxydating power of a solution of a ferricyanid with hydrate of potash, it is suggested that peroxyd of hydrogen is the oxydating agent, as the assimilation of 2K from $2K\,H\,O_2$ will give $H_2\,O_4$; and the same view is extended to the oxydizing action of moist chlorine, for $Cl_2+2H_2\,O_2=2H\,Cl+H_2\,O_4$.

The views of the constitution of the compound ammonias, and the bodies of the kakodyl series, which appeared in this Journal for March 1851, and were republished in the London Philosophical Magazine of May following, are here reproduced; and the newly discovered volatile base piperidine $C_{10}\,H_{11}\,N$, is noticed as homologous with arsine and stibethine. These alkaloids are to the ammonias, what aldehyd is to alcohol, differing by H_2. Strecker's fine researches on the bile are embodied, and the close association of the sulphur-acid with the other species, serves the author to illustrate his idea of the protein bodies, which he regards as mixtures of a species containing sulphur, with a normal species having the composition of an amid, or rather nitryl of cellulose, and represented by $C_{24}\,H_{17}\,N_3\,O_8$; so that it may produce $C_{24}\,H_{20}\,O_{20}$ and $3N\,H_3$ by taking up $6H_2\,O_2$. The different forms of protein are compared to the isomeric bodies, cellulose, starch, and dextrin.

Gelatin is regarded as a similar derivative of glucose, with four equivalents of ammonia, and to be $C_{24}\,H_{20}\,N_4\,O_8$, capable of regenerating grape sugar and ammonia by taking up $8H_2\,O_2$. These formulas, supported by a comparison with many analyses, and by the peculiar reactions of gelatin and protein, have already been published in this Journal,* and noticed with high commendation, by the editors of the Comptes Rendus des Travaux de Chimie, Messrs. Laurent and Gerhardt.†

There are many other subjects of interest in this little treatise, and we recommend its perusal to all chemical students.

2. *A Memoir on the Equinoctial Storms of March–April*, 1850: *an Inquiry into the extent to which the Rotatory Theory may be applied*; by F. P. B. Martin, Esq., (Athenæum, No. 1294.)—From the notices which have from time to time appeared in the pages of the *Athenæum* our readers have been made well acquainted with the main points of the theory of storms. The work before us—which is not published—

* See this Journal for Jan., 1848, p. 74—Sept., 1848, p. 259, and Jan., 1849, p. 109.
† Comptes Rendus des Trav. for 1850, p. 317.

is a collection, from all available sources, of such information as tends to prove the correctness of the rotatory theory, as applied not merely to the storms of the tropics, but to those also which occasionally strew wrecks upon our own shores. An immense mass of information has been gathered together, consisting mainly of extracts from logs, meteorological registers, &c., which cannot but prove eminently useful to all who are interested in the solution of the problem. From a careful examination of Mr. Martin's examples and reasonings, we feel convinced of the correctness of his views. Further information is promised; and judging from the character of that before us, it is likely to be of much value. This would, however, be very considerably increased if the book were to pass through the hands of a publisher:—by which means a better style of printing would be insured, and the the book would be procurable by those who may require to consult its tables. [The theory advocated is essentially that of Mr. Redfield.]

3. *Curiosities of the Microscope;* or Illustrations of the Minute Parts of Creation; adapted to the capacity of the Young, with colored Illustrations; by Rev. Jos. Wythes, M.D., author of the Microscopist, etc. 132 pp. Philadelphia, 1852. Lindsay & Blakiston.—This is a beautiful little book for children, beautiful in its printing, its colored plates and its whole getting up; and is well adapted to instruct and amuse those for whom it is intended. There are 12 plates, containing numerous figures, drawn with much care, even to minute details. The spirit of the work is excellent, and we wish it in the hands of all the children of the land.

4. *Analytical Physics, or Trinology;* a New Theory of Physical Science; by Robert Forfar. 120 pp. 12mo. London, 1852. H. Baillière.—The author opposes the common doctrine of "attraction," arguing that cold is a positive agent distinct from heat, and that the two antagonistic elements, heat and cold constitute the motion-producing cause throughout the universe. Such a conclusion requires better evidence for its support than the author has brought forward.

5. *Lectures on the Electro-magnetic Telegraph, with an historical account of its rise and Progress*, containing a list of the number of Telegraphic lines of the world, illustrated by 56 wood cuts and 2 copper-plate engravings; with an Appendix containing the decisions of Judges Woodbury and Kane in the celebrated Telegraphic trials; by Laurence Turnbull, M.D., Lecturer on Technical Chemistry at the Franklin Institute of Pennsylvania. 140 and 46 pp. 8vo. Philadelphia, 1852.—The different kinds of Electric Telegraphs are well illustrated and described in this work, with full details; and the elementary principles upon which they operate are explained so as to bring the whole subject within the comprehension of minds uneducated in science. The lines of Morse's Telegraph in the United States have a length of 15,835 miles; and House's and Bain's lines are each about 2,000 miles long, making in all 20,047 miles. In England, Scotland and Ireland, the whole length is stated at 2,150 miles; in Prussia, 1,493 miles; in Austria, 1,053 miles; in France, 400 to 600 miles.

6. *Annals of Science, being a Record of Inventions and Improvements in applied Science*, conducted by J. Hamilton Smith, A.M., Cleveland, Ohio, 1852. $1 a year.—The Annals of Science made its first

appearance on the 15th of October, and is issued in semi-monthly numbers of 16 pages, large 8vo. It is devoted to practical and theoretical science, treating, in its articles and selections, of the subjects of astronomy, geology, zoology, meteorology, physics, practical chemistry and the general applications of science, and is calculated to do much for the progress and diffusion of knowledge. Judging from the numbers which have been issued, and our personal acquaintance with the editor, Mr. Smith, we are assured that the work will be well conducted, and will thus commend itself to the favor and substantial support of all who care to know of the discoveries in science that are daily coming to light.

7. *Annals of the Astronomical Observatory of Georgetown College, D. C.;* No. I, containing the description of the Observatory, and the description and use of the Transit Instrument and Meridian Circle. 216 pp. 4to, with 8 plates.—The Observatory at Georgetown was erected mainly for the instruction of students, and this first volume of the Annals contains, as the author, Prof. James Curley, states in his preface, a simple account of what was done in building the house and mounting some of the instruments, and also a full explanation, adapted to young persons, of almost every thing connected with the Transit Instrument and Meridian circle; together with an explanation of the method of finding the difference of longitude by meridian observations of the moon and the stars near her. The longitude of the Observatory is stated at 77° 4′ 33″ west of Greenwich, and the latitude 38° 54′ 26″ north.

8. *The American Polytechnic Journal*, a new Monthly Periodical, devoted to Science, Mechanic Arts and Agriculture, conducted by Prof. Chas. G. Page, M.D., late Chief Examiner of Patents, J. J. Greenough, M.E., C. L. Fleischmann, C.E.—This new Journal, the first number of which is annonnced to appear in January, is under the general supervision of Prof. Page, for the departments of Physical and Chemical Science, Mr. Greenough for the Mechanic Arts, and Mr. Fleischmann for Agriculture. This Journal has the advantage of high ability in its editorial corps, and from its practical character combined with scientific excellence, it must secure extended popularity, and prove of great value to the science and arts of the country. Its position at Washington, where the Patent Office is established, gives it great advantages. The monthly numbers will contain about 70 pages, and be fully illustrated by engravings.

9. *The Canadian Journal*, a Repository of Industry, Science and Art; and a Record of the Proceedings of the Canadian Institute. Toronto, Upper Canada. Published by H. Scobie, for the Council of the Canadian Institute.—A monthly 4to Journal, of the above title, was commenced at Toronto in August last. The departments of Practical and Scientific Agriculture, Mechanics, Geology, Chemistry and Physics are represented among the articles in the August and September numbers. We observe the name of Captain Lefroy, of the Toronto Observatory, among its contributors.

10. *Palæontographical Society.*—The Palæontographical Society has just issued a volume for 1852, containing a Monograph of the British Fossil Corals, by H. Milne Edwards and Jules Haime, 3d part, Corals from the Permian formation and the Mountain limestone, with 16 4to plates; a Monograph of British Tertiary Cretaceous, Oolitic

and Liassic Brachiopoda, by Thos. Davidson, Parts I, II, and III. with 18 plates; a Monograph of the Eocene Mollusca, or Descriptions of Shells from the older Tertiaries of England, by Frederick E. Edwards, Part II, Pulmonata, with 6 plates; a Monograph of the Echinodermata of the British Tertiaries, with 4 plates, by Prof. E. Forbes.

The illustrations of the publications of the Palæontographical Society are of remarkable beauty, and the works issued are worth—comparing them with the books of the trade—five times what they cost. By a payment of a guinea a year, any person is entitled to the volume or volumes of that year. To the geologist they are indispensable.

11. *Quarterly Journal of Microscopic Science*, including the Transactions of the Microscopical Society of London, edited by Edwin Lankester, M.D., F.R.S., F.L.S., and George Busk, F.R.C.S.E., F.R.S., F.L.S.—The first number of this Journal was issued in October. It contains various papers on microscopic subjects and is illustrated by four lithographs. It will be found a valuable acquisition to all who are interested in microscopic investigations, and to zoologists generally. The amateur microscopist is often in want of subjects for investigation, or needs a hint from some one skilled in science as to the objects of interest around him. The Journal of Microscopic Science coming to him quarterly will supply what in this respect he needs, besides giving the results of profound researches of microscopists abroad. We direct attention to the Prospectus of this Journal published with this number of our Journal.

12. Alexis Perrey, (Prof. à la Faculté des Sciences de Dijon.)—*Mémoire sur les Tremblements de Terre ressentis dans la Peninsule Turco-hellenique et en Syre.* From the Mem. Couronnés, etc., Acad. Roy. de Belgique, vol. xxiii.—Note sur les Tremblements de Terre ressentis, en 1847, 12 pp. 8vo; en 1848, 8 pp. 8vo, Bull. Acad. Roy. de Belg., vol. xvi; en 1849, suivie d'un Supplément pour 1847 et 1848, 22 pp. 8vo, Bull. Acad. Roy. de Belg., vol. xvii; en 1850, 20 pp. 8vo, Bull. Acad. Roy. de Belg., vol. xviii.

——— *Documents relatifs aux Tremblements de Terre dans le nord de l'Europe et de l'Asie.* St. Petersburg, Acad. Impér. des Sciences, 1849. 32 pp. 4to.

——— *Mémoires sur les Tremblements de Terre aux Etats-Unis et dans le Canada.* 62 pp. 8vo. Extrait des Annales de la Société d'Emulation, vol. vii, 1850.

Prof. Perrey, as the titles of his works shows, is engaged in a thorough investigation of earthquakes. His researches have been carried forward with great energy, and he already looks towards generalizations of much importance, with regard to the unequal prevalence of earthquakes in the different regions of the globe, in different years, and in the different months of the year. In his paper on American earthquakes, he has gone over the early historical documents relating to the country, and thereby he has brought together a great number of facts that had been forgotten. We should be glad to cite from this paper at length, had we space. It will be doing much for this department of science, if any persons having records of earthquakes or making observations at the present time, will send a copy of them to Prof. Perrey at Dijon. The facts will be most gladly welcomed by

him, and will be placed on record in some of the journals of the day, or publications of societies.

13. *Norton's Literary Register*, 1853; by C. B. NORTON, New York. 12mo., 1852, 25 cts.—Mr. Norton by his Literary Advertiser, and the Register here issued, is doing much to distribute a knowledge of the Publications coming monthly from the Press both in this country and abroad. The Literary Register for 1853 contains a list of American and English publications for 1852, a list of Publishers, a Catalogue of the Libraries in the United States, with particular descriptions of the Libraries of Harvard College, Yale College, and Brown University, and of the Worcester Antiquarian Library, the New York State Library, and Redwood Library. An almanac for 1853 is also connected with the Register. The volume is prepared with care and will be found highly useful.

R. HOGG: British Pomology. *London.*

A. DE QUATREFAGES: Observations sur les Notiluques; Memoire sur la Phosphorescence de quelques Invertébrés marins; Etudes sur les Types Inferieurs de l'embranchement des Annelés. 170 pp. 8vo, with several plates. From the Ann. des Sci. Nat. [3], vol. xiv.

C. F. RAMMELSBERG: Lehrbuch der Krystallkunde, oder Anfangsgründe der Krystallographie, Krystallophysik und Krystallochemie. 236 pp. 8vo, with 250 woodcuts and 3 plates. *Berlin*, 1852.

G. FORCHHAMMER, J. STEENSTRUP and J. WORSAAE: Undersögelser i geologisk-antiqvarisk Retning. Fortsættelse Nr. 1. *Copenhagen*, 1852.

G. FORCHHAMMER: Hans Christian Œrsted; et Mindeskrift læst i det Kongelige danske Videnskabernes Selskabs Möde den 7de November, 1851. *Copenhagen*, 1852.

G. FORCHHAMMER: Oversigt over det Kgl. danske Videnskabernes Selskabs Forhandlinger, og dets Medlemmers Arbeider i Aaret, 1851. *Copenhagen.*

H. RINK: Om den geographiske Beskaffenhed af de danske Handelsdistrikter i Nordgrönland, tilligemed en Udsigt over Nordgrönlands Geognosi. 62 pp. 4to, with a chart. *Copenhagen*, 1852. Among the minerals of North Greenland there are noticed, hornblende, dolomite with tremolite, suhlite and actinolite, molybdena, titanite, idocrase, staurotide, mica, labradorite, anthophyllite ($\dot{F}e^3\ \ddot{S}i^2 + 3(\dot{M}g^3\ \ddot{S}i^2)$), a silicate of magnesia ($(\dot{M}g, \dot{F}e)^6\ \ddot{S}i^5$); also in connection with trap, chabasite, levyne, mesotype, stilbite, okenite, analcime, native copper, and chrysocolla, nephrite and jasper, calc spar, arragonite, quartz crystal and chalcedony.

PROCEEDINGS BOST. SOC. NAT. HIST.—October, 1852. p. 209. Skeleton of the Chimpanzee; p. 210. *C. Girard*, on Niobe (Girard) zonata, from the harbor of Boston, N. limacina (=Planaria limacina, *Fabr.*), Fovia (Girard) Warrenii, of Chelsea Beach, Dugesia Foremanii, from near Washington, D. C., Amphidetus Kürtzii.—p. 214. Synapta pellucida, n. sp.; *Stimpson* and *Kürtz.*—p. 220. Officers for the ensuing year—J. C. Warren, President, C. T. Jackson and D. H. Storer, Vice Presidents, J. Eliot Cabot, Corresponding Secretary, N. B. Shurtleff, Treasurer, C. K. Dillaway, Librarian.—p. 222. Axius serratus, n. sp.; *Stimpson.*—p. 223. Remarks on the Ophisaurus ventralis; *Dr. Burnett.*—p. 224. Two new species of Ophiolepis; *Stimpson.*

JAHRESBERICHT DES NATURWISSENSCHAFTLICHEN VEREINES IN HALLE, 2nd year—June, 1849, 1850, 162 pp. 8vo, with 1 plate; 3d year, 1850, 190 pp. with 3 plates; 4th year, 1851, 306 pp. with 4 plates; 5th year, 1852, 1st and 2nd parts, 208 pp. with 3 plates.

BULLETIN DE LA SOCIÉTÉ IMPERIALE DES NATURALISTES DE MOSCOU, Nos. 3 and 4, 1851, and No. 1, 1852.—No. 3, contains papers on Russian Staptylinæ, by *I. H. Hochhuth*; undescribed Synanthereæ, by *Turczaninow*; new species of Daphnia, by *S. Fischer*; Limaces of Ukraine, etc., by *Kaleniczenko*; No. 4, contains Flora baicalensi-dahurica, by *Turczaninow*; new species of Cyclopidæ, by *S. Fischer*; Russian Lepidoptera, by *v. Nordmann*; on waves, by *A. Popoff*; new Caucasian Plants, Sethegleeff; new Coleoptera, by *Motschoulsky*, etc. No. 1, contains, new Carabaci, by *Chaudoir*; Russian Moths, by *Eversmann*; fossil fishes of Russia, with 2 plates, by *G. Fischer de Waldheim*; on waves, by *A. Popoff*; on the tyraïque system, 1st part Terrains hemelysiens, by *Andrzeiowski*, etc.